SPACE TRANSPORTATION SYSTEM PAYLOADS MISSION CONTROL STUDY

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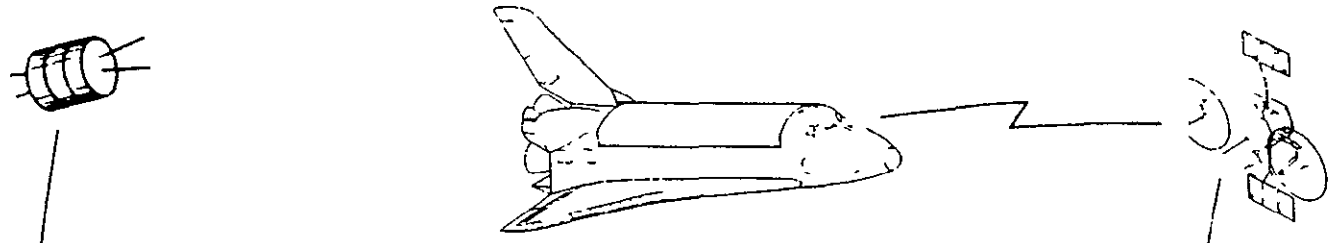
CONTINUATION PHASE A-1

VOLUME II-A



FINAL STUDY REPORT FOR TASK 1

JOINT PRODUCTS AND FUNCTIONS FOR PREFLIGHT PLANNING OF FLIGHT OPERATIONS, TRAINING AND SIMULATIONS

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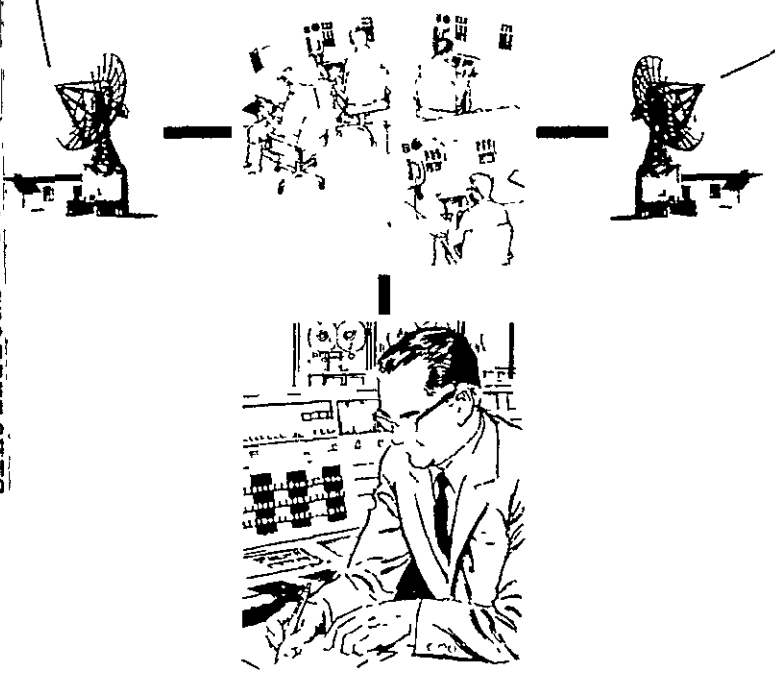

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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FINAL REPORT
FOR
STS PAYLOADS MISSION CONTROL STUDY
CONTINUATION PHASE A-1

TASK 1
JOINT PRODUCTS AND FUNCTIONS FOR PREFLIGHT PLANNING OF FLIGHT OPERATIONS, TRAINING AND SIMULATIONS

NAS9-14484 JUNE 1976

Prepared for
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FOREWORD

This document represents one Section of the FINAL REPORT for the STS PAYLOADS MISSION CONTROL STUDY CONTINUATION PHASE A-1, prepared by TRW Defense and Space Systems Group under Contact NAS9-14484, with NASA, Lyndon B. Johnson Space Center. The complete list of documents that comprise the FINAL REPORT of this Study is as follows:

- Volume I - Integrating Summary Report
- *Volume II-A - Study Task 1 - 1.0 Joint Products and Functions for Preflight Planning of Flight Operations, Training and Simulations
- Volume II-B - Study Task 2 - 2.0 Refinement of Implementation Guidelines for Selected STS Payload Operator Concept
- Volume II-C - Study Task 3 - 3.0 Joint Preflight Activities in Preparation for STS Payload Flight Operations

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1.0 TASK 1 - JOINT PRODUCTS AND FUNCTIONS FOR PREFLIGHT PLANNING OF FLIGHT OPERATIONS, TRAINING AND SIMULATIONS

1.1 INTRODUCTION

1.1.1 Background Discussion

This study phase, A-1, represents a continuation of the basic STS Payloads Mission Control Study which produced a set of concepts and preliminary implementation guidelines for performing payload flight operations control. (The complete set of results from the basic study is given in References 1 through 18.) Phase A-1 places emphasis on the prelaunch activities required to prepare for the payload flight operations.

This report is part of the Phase A-1 Study which has been divided into three tasks associated with the three specific study objectives as follows:

Task 1 Objective: To define specific products and functions, and associated facility availability, applicable to preflight planning of flight operations and training and simulation activities involving joint participation of STS and Payload Operations organizations, respectively.

Task 2 Objective: To evaluate and further develop the STS payloads operations concepts defined during the basic Study, including (1) refinement of implementation guidelines for cost-effective Payload Operations Control Centers (POCC's) and (2) definition of interfaces among STS Operator and Payload Operator elements for preflight and flight operations activities.

Task 3 Objective: To identify joint preflight activities and develop estimated composite joint resources required to implement preflight activities in preparation for STS Payload flight operations, training and simulations based on given flight traffic and payload assignment models.

This document contains the results of Task 1, which includes identification and allocation of joint STS-Payload Operator preflight planning tasks for flight operations, and training and simulation activities. The Phase A-1 Study activity encompasses operations for the post-OFT period, 1980-91, with same flight type/payload model and same traffic model as the basic study.

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1.1.2 Task 1 Description and Scope

In Task 1, products and functions are identified which will be used during preflight planning of joint STS/Payload flight operations, and the planning (and conduct) of joint training and simulation exercises designed to certify the capabilities of flight and ground personnel. Functional areas receiving major emphasis include: (1) establishing flight requirements, (2) flight planning, (3) flight operations planning, and (4) training and simulations planning. Facilities which are candidates for joint use in preflight planning of joint flight operations, training and simulations will also be identified.

Then, the generation and/or implementation of products and functions are allocated to the primary NASA Operating Centers involved in the STS/Payload Programs based on: (1) the primary responsibility of the Center; (2) the planning, training or simulations facilities available; and (3) the nature of the product or function to be allocated.

1.1.3 Detailed Scope

In this study, products and functions related to Payload operations control or support are allocated the most ideally suited Center. The study does not allocate tasks directly at levels below the Center level, i.e., Mission Control Center, Payload Operating Center, or Network Operations Center. Reallocation of tasks to organizations at lower levels of participation than Center level is a prerogative of the NASA Centers. This task does not include reallocation of products or functions to other facilities when the primary facility availability is saturated due to operational loading, since actual loading due to flight operations has not been established yet.

This study is complementary to the existing products and functions already identified for implementation within the STS organization. The study is directed at flight operations during the operational phase of the STS Era, beginning at the end of the OFT phase in CY1980 and continuing through CY1991. It is expected that the Program will mature in an evolutionary manner during the operational phase.

This study addresses only those products and functions applicable to those flight phases that involve both the STS vehicles and the Payload, i.e., the entire Spacelab flight (as presently conceived), and other payloads while onboard the Shuttle or IUS until safely deployed or after retrieval/servicing has begun. The products must be produced, and functions concluded, in that period of time between assignment of a specific cargo or payload to a flight and the launch of that flight.

1.1.4 Task 1 Activity Flow

The Task 1 Activity Flow is presented in Figure 1.1-1. This figure presents a sequential flow of activities required to accomplish Task 1. During the operational phase of the STS Era, the activity loading on facilities already participating in STS flight operations will be an added consideration.

1.1.5 Key Assumptions and Guidelines

Key assumptions and guidelines applicable to Task 1 of Phase A-1 are as follows:

- Emphasis is placed on joint STS-Payload preflight activities in preparation for joint flight phases.
- Prelaunch period addressed by the study is from assignment of cargo/payload to a flight through commitment for launch.
- The same flight type/payload model and same traffic model as used in basic study applies.
- The study addresses that portion of the traffic model from end of OFT throughout the currently defined Operational Era, 1980-1991.
- Existing NASA capabilities, resources and modus operandi provide a point of departure for this study.
- Payload Operator and STS Flight Operator share responsibility to prepare for joint STS-Payloads Flight Operations.
- Payload Operator has full responsibility to prepare for payload operations during separate freeflight operations.
- Payload flight planning requirements and inputs will be provided by the STS User; the STS Flight Operator will perform STS flight planning and will integrate STS-Payload flight planning for joint flight phases.

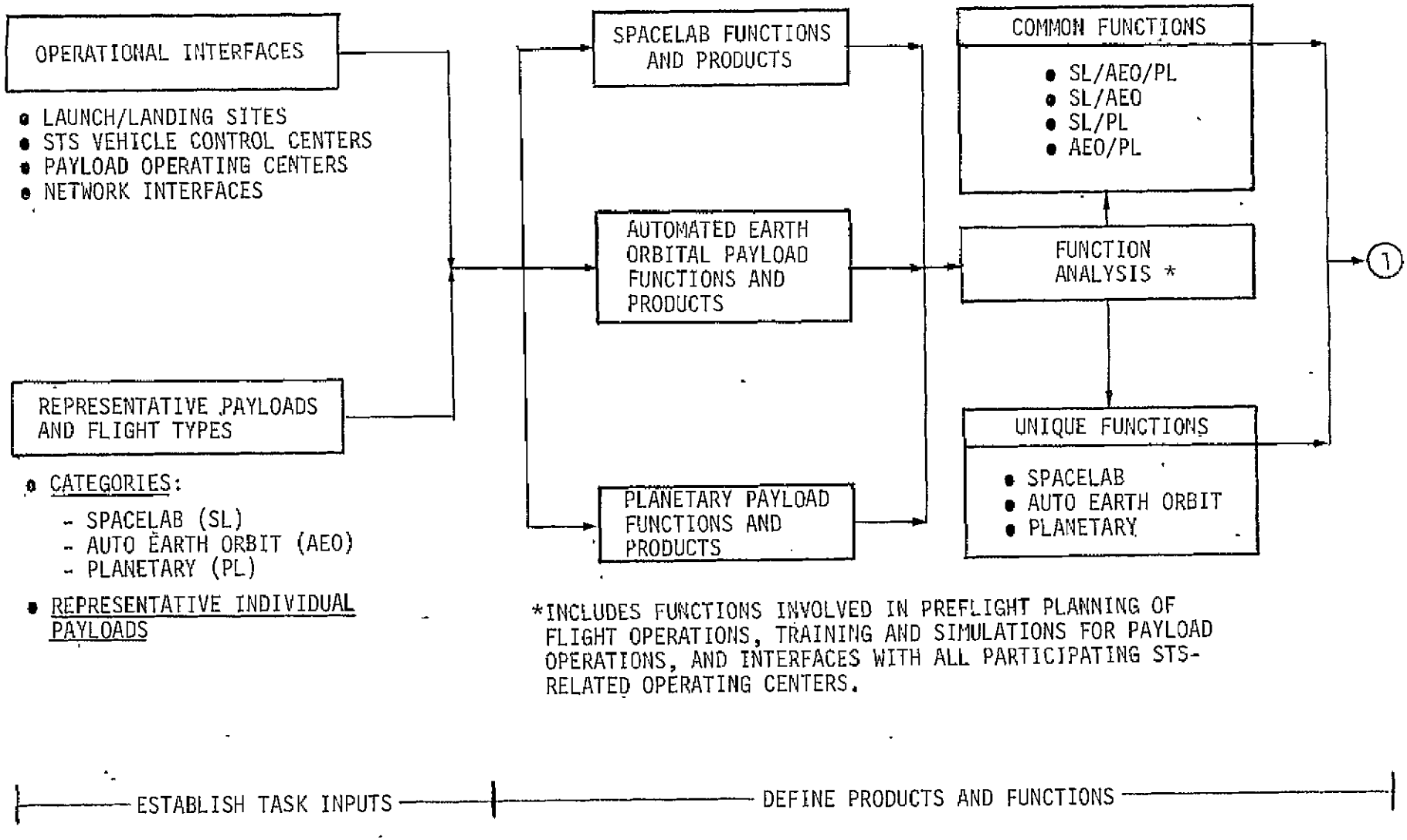

Figure 1.1-1. Task 1 Activity Flow

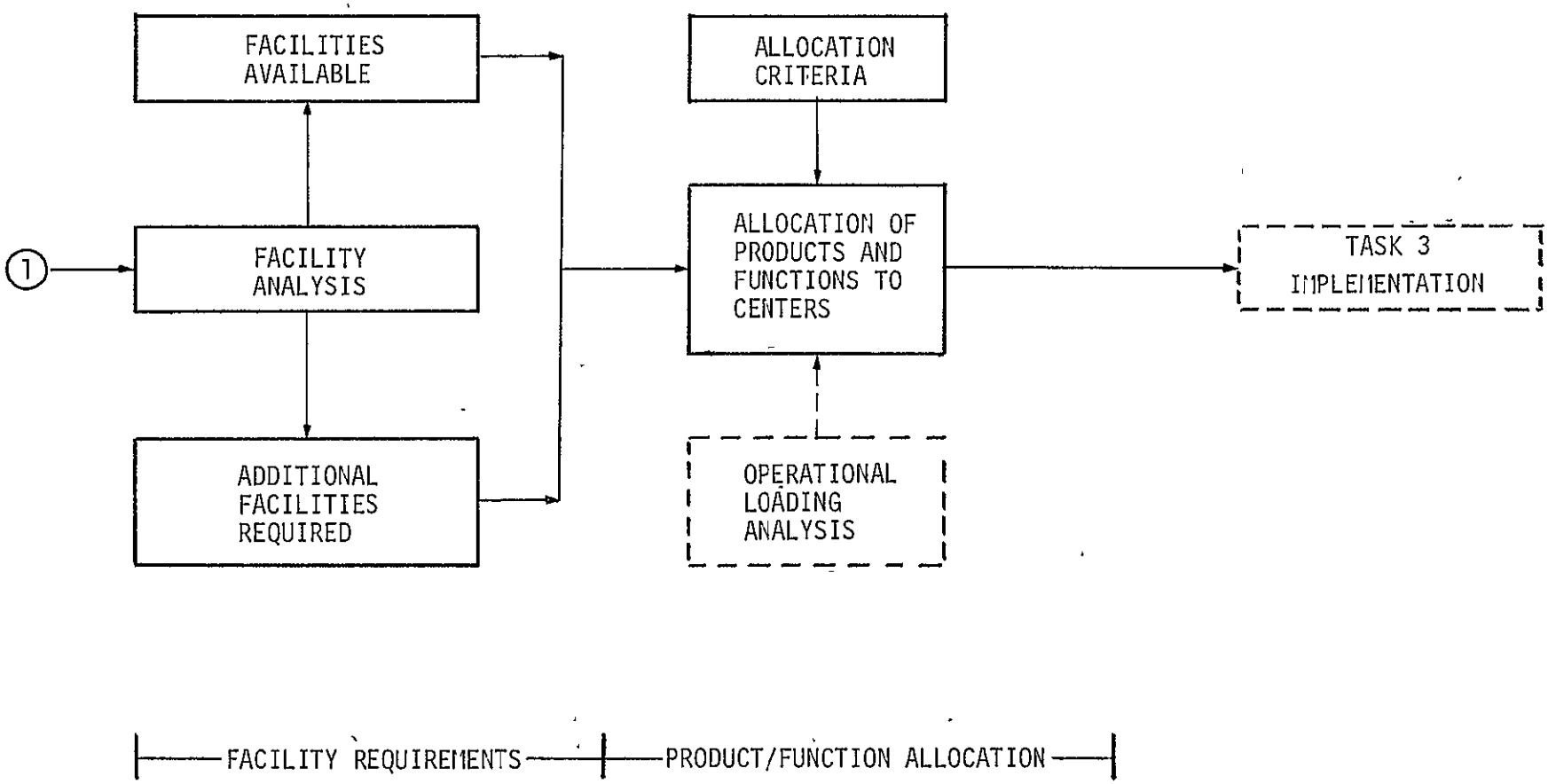

Figure 1.1-1. Task 1 Activity Flow (Continued)

A complete set of study guidelines for Phase A-1 is given in Appendix A to the Study Plan, Reference 13, and the Integrating Summary Report, to be published later.

1.1.6 Acronyms and Abbreviations

AEO	Automated Earth-Orbital (Payload)
AFSCF	Air Force Satellite Control Facility
ALSA	Airlock Simulator Assembly
ALT	Approach and Landing Test
AMPS	Atmospheric Magnetospheric Plasmas in Space
ARC	Ames Research Center
ATL	Advanced Technology Laboratory
ATS	Applications Technology Satellite
ATSSIM	ATS Simulator
BESS	Biomedical Experiments Scientific Satellite
BOP	Baseline Operations Plan
C&W	Caution and Warning
CDR	Commander
COMM	Communications
CPES	Crew Procedures Evaluation Simulator
CPMP	Crew Procedures Management Plan
CRT	Cathode Ray Tube
CY	Calendar Year
DOD	Department of Defense
DOF	Degrees of Freedom
DMSS	Data Management System Simulator
DSN	Deep Space Network
DSS	Data System Simulators (MSFC); Deep Space Stations (JPL)
EMU	Extravehicular Mobility Unit
EOS	Earth Observations Satellite
EPS	Electrical Power System
ERTS	Earth Resources Technology Satellite
ESA	European Space Agency
ETR	Eastern Test Range
EVA	Extravehicular Activity
FAA	Federal Aviation Administration
FBCS	Fixed Base Crew Station
FCR	Flight Control Room
FDF	Flight Data File
FFTO	Freeflyer Teleoperator
FO	Flight Operator
FOD	Flight Operations Directorate (JSC)

GDP	Generalized Documentation Processor
GN&C	Guidance, Navigation and Control
GPL	General Purpose Laboratory
GSFC	Goddard Space Flight Center
HEAO	High Energy Astrophysics Observatory
Hi-Fi	High-Fidelity
IUE	International Ultraviolet Explorer
IUESIM	IUE Simulator
IUS	Interim Upper Stage
IUSS	IUS Simulator
JPL	Jet Propulsion Laboratory
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
LAGEOS	Laser Geodynamic Satellite
LANDSAT	Land Satellite
LaRC	Langley Research Center
LEO	Low Earth Orbit
LS	Life Sciences
LSO	Launch/Landing Site Operator
LST	Large Space Telescope
MBCS	Motion Base Crew Station
MCC	Mission Control Center
MCC-H	Mission Control Center-Houston
MDS	Mission Development Simulator
MMU	Manned Maneuvering Unit
MOPR	Mission Operations Planning Room
MPSR	Mission Planning Support Room
MS	Mission Specialist
MSE	Mechanical Support Equipment
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NASCOM	NASA World-Wide Communications Network
NB	Neutral Buoyancy
NOCC	Network Operations Control Center
NSP	Network Support Plan
NSS	Network Simulation System
NTTF	Network Test and Training Facility
OAS	Orbiter Aeroflight Simulator
OD	Operations Directive
OFT	Orbital Flight Test
OPS	Operations (Phase)
OR	Operations Requirements

PDC	Payload Development Center
POC	Payload Operations Center
POCC	Payload Operations Control Center
PL	Payload
PLO	Payload Operator
PLT	Pilot
PRD	Program Requirements Document
PS	Payload Specialist
PSP	Program Support Plan
RF	Radio Frequency
RMS	Remote Manipulator Simulator
SBS	Shuttle Bay Simulator
SEOPS	Standard Earth Observations Package for Shuttle
SGOS	Shuttle Ground Operations Simulator
SI	Science Instruments
SIRD	Support Instrumentation Requirements Document
SIS	Shuttle Interface Simulator
SL	Spacelab
SLS	Spacelab Simulator
SMS	Shuttle Mission Simulator
SO	Solar Physics
SOPC	Shuttle Operations Planning Center (DOD)
SP	Space Processing
SPS	Shuttle Procedures Simulator
SSE	Systems Support Equipment
SST	Single System Trainer
STA	Shuttle Training Aircraft
STC	Satellite Test Center (DOD)
STDN	Space Tracking and Data Network
STP	Space Test Program (DOD Payloads)
STS	Space Transportation System
TBD	To Be Determined
TDRSS	Tracking and Data Relay Satellite System
TUG	Space Tug; reuseable booster for exoatmospheric operations
TV	Television
VAFB	Vandenberg Air Force Base
WIF	Water Immersion Facility
WTR	Western Test Range
Zero-G	Weightless Condition
1-G	Normal Earth-Gravity

1.2 APPLICABLE FLIGHT TYPES/PAYLOADS AND OPERATIONAL INTERFACES

As a prelude to Task 1, the flight types and payloads provided as input to the study, per Study Plan Appendix A - Reference 13, were assessed to determine major operational planning characteristics and most suitable operational approach. These assessments were made in discussion with the Project Manager or his designated representative(s) at the appropriate NASA Center.

Specifically, the twelve (12) types of payload flights identified in Tables 1.2-1 through 1.2-4, titled "Payload Project Status and Perspective," were assessed. These payload flight types were addressed in four categories: Spacelab, Automated Earth Orbiting, Multiple Cargo, and Planetary.

The tables include identification of the payload, NASA Center responsible for operating and supporting the payload and project status, as well as key operational characteristics and current approaches to operational planning. More specific data are discussed in the following paragraphs.

1.2.1 Spacelab Payloads (Table 1.2-1)

Spacelab Payloads are assembled on pallets or in modules, or combinations of these units. Most Spacelab payloads contain an experiment or group of experiments dedicated to one discipline, though some represent multidisciplinary projects. These payloads require manned operations to control or support experiments which will often be performed simultaneously. Because of the nature of these payloads and limited flight durations, they must interface closely with both the Orbiter and ground-based flight control/support personnel with regard to data return and operational performance of experiments and vehicles, but the day-to-day operation onboard will be as autonomous as possible. All flight crew personnel must be familiar with basic experiment operations such that the STS flight crew members can assist the payload crew members in experiment operation, or can conduct such operations independently. Because of the complex nature and duration of such flights, extensive planning is required for both flight operations and flight control/support operations at STS and Payload Operations facilities on the ground. The Payload Operations Center (POC) for Spacelab flights is at JSC; this means that Payload Operators for designated Spacelab flights will operate out of JSC or other locations by agreement with JSC.

Table 1.2-1 addresses two basic Spacelab configurations; module and pallet, and pallet only. Since these two configurations are further considered in single discipline and multidiscipline modes, there are four configurations (Flight Types A-D) addressed. There are three Payload Operators (Lead Centers hosted by JSC) identified - LaRC (ATL), GSFC (AMPS and SO) and MSFC (HEA). Flight Type D illustrates a Lead Center-Supporting Center configuration which could become common as payload operations mature.

The dominant operational characteristics from these Spacelab payloads is pointing accuracy, requiring even a secondary pointing system in some cases, such as the GSFC-sponsored "Solar Physics" payload.

Extent of participation by a Payload Specialist onboard varies from "little desired" on GSFC payloads to "heavy crew involvement" or "maximum autonomy" for JSC and MSFC payloads. In either case, all crew members will require training on experiment operations so that STS flight crew members may assist payload crew members when needed.

All the Spacelab payloads in the Study Model, Table 1.2-1, will require significant preflight planning with exception of SEOPS which has been designed to fly as a Hitchhiker. Hitchhikers generally involve minimal crew interface and limited flight planning effort.

1.2.2 Automated Earth-Orbiting Payloads (Table 1.2-2)

Automated Earth-Orbiting payloads are those unmanned payloads which will be delivered directly to orbit by the Orbiter (Low Earth Orbit), or may require an IUS or TUG for delivery outside the Orbiter delivery envelope (geosynchronous orbit). Such payloads may require additional support flights, such as revisit/service flights (with or without EVA) to perform such tasks as to replenish vehicle/experiment consumables, to perform maintenance and/or recover data; and in some cases, recover a complete payload unit. Preflight planning for such flights should be easily developed into modules. Due to the nature of these flights, Payload flight crew members will probably not be required for deployment flights; may or may not be required for recovery flights; and will probably be required for service/resupply flights. The Payload Operations Center (POC) designated for Automated Earth-Orbiting payloads is at GSFC; this means

Table 1.2-1. Payload Project Status and Perspective - Spacelab - Operations Control from JSC POC

FLIGHT TYPE I.D.	FLIGHT TYPE DESCRIPTION	REPRESENTATIVE PAYLOADS	PAYLOAD OPERATOR*	SUPPORTING PAYLOAD CENTER	PROJECT STATUS	KEY OPERATIONAL PLANNING CHARACTERISTICS	OPERATIONAL PLANNING APPROACH
A	SPACELAB MODULE AND PALLET DEDICATED CENTER	ADVANCED TECHNOLOGY LABORATORY (ATL) #1	LaRC		PHASE A STUDY THROUGH JAN. 1977 FLIGHT GOAL 1981 (SL #4)	• SOLAR AND EARTH POINTING ON SHORT FLIGHT	• SMOOTH INTERFACE WITH STS FO • FLEXIBLE ON RESPONSIBILITY
B	SPACELAB MODULE AND PALLET MULTIDISCIPLINE	ATMOSPHERIC MAGNETOSPHERIC PLASMAS-IN-SPACE (AMPS)	GSFC		PHASE B STUDY THROUGH NOV. 1976	• POINTING ACCURACY	• EARLY EMPHASIS - DETAILED EXPERIMENT PRE-SCHEDULING • SMOOTH INTERFACE WITH STS FO
C	SPACELAB PALLET ONLY	SOLAR PHYSICS (SO)	GSFC		PART OF ASP (SO, HEA, UVOA) IN PHASE A	• CRITICAL POINTING ACCURACY	• EXPECT SMOOTH INTERFACE W/STS FO • MINIMUM CREW INVOLVEMENT
D	SPACELAB PALLET ONLY, MULTIDISCIPLINE	HIGH ENERGY - ASTRO PHYSICS (HEA)	MSFC		• HEA NOW ON BALLOON FLIGHTS • DELETED FROM HEAO (WEIGHT)	• CREW ACTIVITY SCHEDULING ALLOW RT RESCHEDULING ONBOARD	• WANT HEAVY PAYLOAD SPECIALIST INVOLVEMENT REAL TIME
		SO		GSFC	PART OF ASP IN PHASE A	• CRITICAL POINTING ACCURACY	• MINIMUM CREW INVOLVEMENT
		STANDARD EARTH OBSERVATION PACKAGE FOR SHUTTLE (SEOPS)		JSC	• PHASES A, B COMPLETE • READY FOR C/D	• PROGRAM OPERATION COMPATIBLE WITH PRIME PAYLOAD	• SELF-CONTAINED HITCHHIKER AT L -2 WEEKS • LITTLE CREW INTERFACE

* The Payload Operator is assumed to be the Lead Payload Center.

Table 1.2-2. Payload Project Status and Perspective - Automated Earth Orbiting - Operations Control from GSFC POC

FLIGHT TYPE I.D.	FLIGHT TYPE DESCRIPTION	REPRESENTATIVE PAYLOADS	PAYLOAD OPERATOR*	SUPPORTING PAYLOAD CENTER	PROJECT STATUS	KEY OPERATIONAL PLANNING CHARACTERISTICS	OPERATIONAL PLANNING APPROACH
E	FREEFLYER DELIVERY	EARTH OBSERVATION SATELLITE (EOS)	GSFC		• EOS (LANDSAT) AND ERTS/LANDSAT FLIGHT EXPERIENCE • ONBOARD MMS	• OPTIMIZE INSERTION POINT	• STANDARD INTERFACE FOR FREE-FLYER DELIVERIES • GSFC DEFINE FLIGHT REQUIREMENTS L -2 YEARS
F	DELIVERY AND RETREIVAL	SPACE TELESCOPE (ST) DELIVERY	MSFC	GSFC (ST/SI)	• ST (2 4M APER) FORMERLY LST (3 0M APER) • 7 TO 14 DAY FLIGHT TO DEPLOY • "NATIONAL OBSERVATORY IN SPACE"	• OPTIMIZE INSERTION WITH HEAO-C RECOVERY • TV COVERAGE OF DEPLOYMENT • POTENTIAL EVA IF RELEASE HANGUP • POTENTIAL LIMITED SPACE IN CARGO BAY FOR HEAO-C RETRIEVAL EQUIPMENT • ST WANTS 30 MIN - TDRS/REVOLUTION	• WANT STS FO TO DEVELOP FDF, ST PROJECT REVIEW • WANT STS FO TO SIMULATE DEPLOYMENT • ST PROJECT WANTS NO PART I.I ABORT DECISION • RETRIEVAL OF FIRST ST FOR SERVICING
		HEAO-C RETRIEVAL	MSFC		• PLAN FOR RETRIEVAL FIRM • EXPECT LAUNCH ON ATLAS-CENTAUR JUL 1979 • MUST RETRIEVE BY AUG. 1981	• TIMING OF RETRIEVAL IMPORTANT (WITHIN 2 YEARS AFTER INSERTION) • OPERATE 6 MONTHS ORBIT DECAY 1 YEAR TO 200 NM (i = 45°) • MUST DEFINE MECH INTERFACE W/STS FO • TRACKING METHOD FOR RETRIEVAL OPEN	• NO POCC IN OPERATION AT TIME OF RETRIEVAL • HEAO PROJECT DEPENDING ON STS FO FOR RETRIEVAL PLANNING OPERATIONS • TRACKING BY NORAD • NEED CREW BEFORE, DURING, AFTER RETRIEVAL
G	REVISIT/SERVICE WITHOUT EVA	EOS	GSFC		• EOS (LANDSAT) AND ERTS/LANDSAT FLIGHT EXPERIENCE • ONBOARD MMS	• ACCURATE RENDEZVOUS POINT AND ATTITUDE CONTROL • MUST DEFINE MECH INTERFACE WITH STS FO FOR SERVICING	• GSFC PROVIDE CREW ACTIVITY PLAN FOR SERVICING • PAYLOAD TRAINING FOR SERVICING • ADD DEPLOYABLE HITCHHIKERS
H	REVISIT/SERVICE WITH EVA	ST	MSFC		• ST (2 4M APER) FORMERLY LST (3 0M APER) • FLIGHT TO DEPLOY	• ACCURATE RENDEZVOUS POINT AND ATTITUDE CONTROL • EVA CAPABILITY FOR POTENTIAL PART REPLACEMENT • VERIFY TRAINING/ SIMULATIONS CAPABILITY FOR SERVICE TASKS	• ORBITER ACTIVE, ST PASSIVE FOR CAPTURE • ST PROJECT WORK CHANGEOUT DETAILS WITH CREW, ALL PARTS • RETRIEVE PAYLOAD FOR MAJOR REFURBISHMENTS

* The Payload Operator is assumed to be the Lead Payload Center.

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that Payload Operators for designated Automated Earth-Orbit Payload flights will operate out of GSFC or other locations by agreement with GSFC.

Flight Type F in Table 1.2-3, Space Telescope delivery and HEAO-C retrieval, presents a potentially very interesting flight. HEAO-C retrieval is a real requirement and ST is a trimmed-down version of LST (aperture reduced from 3.0 M to 2.4 M). HEAO-C must be retrieved by August 1981, assuming launch in July 1979, due to orbit decay expected. Since there will be no POCC for HEAO-C still in operation when retrieved, some other means of tracking and performing other POCC functions will be needed, such as use of NORAD. Another concern of the HEAO-C Project is whether there is sufficient space to load onboard payload retrieval equipment together with the ST and its associated equipment.

Most delivery, retrieval and revisit/servicing flights should be routine, with "standard planning modules" applicable.

1.2.3 Multi-Cargo Payloads (Table 1.2-3)

Multiple-cargo payloads may consist of Spacelab-type and/or automated payloads, but generally these payloads are composed of multiple experiments which may or may not be related. Interfacing these payloads with the STS vehicles and ground-based STS and Payload Operation Centers will require planning similar to or more complex than that required for Spacelab payloads. Preflight planning for flight activities and control/support from STS and Payload Centers will also require significant efforts, with heavy emphasis on training and simulation exercises to certify procedures for real-time operations. Payload flight crew personnel will probably be required for all multiple cargo payloads. The POC's for Multi-Cargo payloads should be assigned on a flight-by-flight basis, probably to the Center most closely associated with the predominant part of the payload (Spacelab or Automated).

Multi-Cargo Flight Type I in Table 1.2-3 could be modified as shown to reflect latest version of the LAGEOS-CLOGEOS freeflyer family under consideration, plus a "robot-type" teleoperator experiment to be used inside the Orbiter Bay in lieu of a "freeflyer" teleoperator outside the Orbiter. For purposes of this study, the original LAGEOS and teleoperator configurations can be used.

Table 1.2-3. Payload Project Status and Perspective - Multi-Cargo - Operations Control from GSFC (I) and JSC (J) POC's

FLIGHT TYPE I D	FLIGHT TYPE DESCRIPTION	REPRESENTATIVE PAYLOADS	PAYLOAD OPERATOR *	SUPPORTING PAYLOAD CENTER	PROJECT STATUS	KEY OPERATIONAL PLANNING CHARACTERISTICS	OPERATIONAL PLANNING APPROACH
I	MULTI-CARGO DELIVERIES FREEFLYER DELIVERY	BIOMEDICAL EXPERIMENTAL SCIENTIFIC SATELLITE (BESS)	ARC		• MOSTLY ANIMAL EXPERIMENT/CELLS • IN PHASE A, FREEFLYER CONCEPT, LATER, DOCKING HATCH FOR MAN SERVICING • FUTURE OF BESS MAY DEPEND ON AVAILABILITY OF LONG DURATION SPACE STATION TO DO SAME JOB	• MAINTAIN LONG DURATION ORBIT (UP TO 1 YEAR) WITHOUT KICK STAGE • SCHEDULING REVISIT AT 6 MONTHS • LATER, NEED DOCKING MECHANISM FOR MAN SERVICING OF ANIMALS (IN SPACELAB MODULE) • ENVIRONMENT CONTROL FOR ANIMALS INCLUDED • ACCELERATION $<10^{-3}$ g's)	• PAYLOAD SPECIALIST ONBOARD TO SERVICE ANIMALS/EXPERIMENTS BEFORE DEPLOY • STS FO RESPONSIBLE FOR DEPLOY PROCEDURE, PAYLOAD OPERATOR MONITOR/SERVICE UNTIL DEPLOY
	FREEFLYER DELIVERY	CLOGEOS (CLOSE-GRID GEODYNAMIC SATELLITE) 100 KM FOP CLOGEOS VERSUS 1000 KM FOR LAGEOS NOTE CLOGEOS REPLACES MINI-LAGEOS IN MODEL		MSFC	PRE-PHASE A FOR INTERCONTINTAL MEAS BASELINE ACTIVE SYSTEM ONBOARD, PASSIVE, INEXPENSIVE GND STATIONS, GND CONTROL RANGING SYS , PRE-PROCESSED PROCESSED DATA	• POLAR ORBIT, 200-300 MI • LONG DURATION OPERATION PHASE (5-10 YEARS) PRECEDED BY VERIFICATION PHASE (1-2 YEARS) • REQUIRE C/O PREDEPLOY - PASSIVE TO ORBIT • RETRIEVE AND RETURN TO EARTH FOR SERVICING	• TIMELINE AND PROCEDURES FOR PREDEPLOY C/O BY PROJECT • STANDARD INTERFACE FOR FREEFLYER DELIVERY NOTE LAGEOS FORERUNNERS TO CLOGEOS PROPOSED BY GSFC (LASER RANGING) AND MSFC (SCANNING LASER RANGING)
	ONBOARD ROBOT	TELEOPERATOR ORBITER BAY EXPERIMENT (TOBE) NOTE TOBE REPLACES FREEFLYER TELEOPERATOR (FFTO) PROJECT WHICH HAS BEEN DISCONTINUED		MSFC	PHASE A TOBE = MANIPULATOR MECHANISM AND VISUAL SYSTEM IN ORBITER CARGO BAY MOVES CARGO, TIGHTENS SCREWS, ETC. (ROBOT)	• NEED SUN AND DARK CONDITIONS FOR VISUAL PART OF TEST - WITH CARGO BAY DOORS OPEN • TRAINING AND SIMULATIONS FOR REMOTE CONTROL OF ROBOT DEVICE APPLICATIONS	• TEST ON ORBITER FLIGHT, EARLY 80'S • EXPERIMENT CONTROL FROM ORBITER (NOT GROUND)
J	MULTICARGO	LIFE SCIENCE (LS)	JSC		COMPLETED TWO 7-DAY FLIGHT SIMS	• NEED LONGEST POSSIBLE FLIGHTS	WELL REHEARSED, INCLUDING DOCUMENTATION
	SPACELAB MODULE ONLY, DEDICATED DISCIPLINE	LS		ARC	FLIGHT SIMS	• LONGER FLIGHTS	WELL REHEARSED, INCLUDING DOCUMENTATION
	FREEFLYER DELIVERY	EXPLORER		GSFC	• FLOWN ON SCOUT • GROWTH FOR TDRSS, POWER, PROP	• USES SPRING-EJECT DEPLOYMENT - MUST MINIMIZE EFFECT ON LS EXPERIMENTS	• SIMPLE PLANNING INTERFACE • FLEXIBLE ON INSERTION POINT • NOT ON MMS
	FREEFLYER DELIVERY	STP (DOD)		SAMSO/DOD	SEVERAL STP PAYLOADS FLOWN	SUITABLE ORBIT RELEASE POINT	STANDARD NASA/DOD INTERFACE TO HANDOVER

* The Payload Operator is assumed to be the Lead Payload Center.

Flight Type J is the second multi-cargo configuration in the model. The heavy emphasis on Spacelab Life Science experiments indicates need for longest possible Spacelab portion of the flight. Another operational planning consideration is the "spring ejection" characteristic of the Explorer payload which should be programmed to minimize any adverse effect on results of Life Science experiments.

1.2.4 Planetary Payloads (Table 1.2-4)

Planetary payloads require an IUS or Tug for delivery to their final trajectory, since these flights extend outside the Earth sphere of influence. Two such payload flights are included in the study model-Mariner and Pioneer. Payload flight crew members may or may not be required for these flights (TBD). No unusual joint planning, training or simulation activities should be required when compared to Automated Earth-Orbiting payload flights; however, flight planning will place greater emphasis on development of an accurate trajectory to produce the required planetary flight path conditions. Once the boost vehicles and spacecraft are deployed, joint operations related to these flights are essentially terminated. The POC designated for these flights is at JPL, which is responsible for payload checkout in Earth orbit as well as regular flight operations.

1.2.5 Operational Interfaces

The Operational Interfaces required for planning, training and simulation of joint flight crew operations and ground-based control/support activities of the STS/Payload Operators can be divided into two main categories; the interface between the planning sections of the STS and Payloads Operating Centers, and between the Payload organization and the launch Center. These interfaces are shown in Figure 1.2-1, Joint Operational Interfaces for Planning, Training and Simulations.

1.2.5.1 STS/Payload Planning Segment Interface

An operational interface must be established between the STS organization and Payload organizations responsible for planning joint orbital control/support functions. The primary purposes of such an interface are threefold:

- Planning of integrated real-time joint flight control or support activities based at the operating Centers;

Table 1.2-4. Payload Project Status and Perspective - Planetary - Operations Control from JPL POC

FLIGHT TYPE I.D.	FLIGHT TYPE DESCRIPTION	REPRESENTATIVE PAYLOADS	PAYLOAD OPERATOR*	SUPPORTING PAYLOAD CENTER	PROJECT STATUS	KEY OPERATIONAL PLANNING CHARACTERISTICS	OPERATIONAL PLANNING APPROACH
L	PLANETARY (IUS)	MARINER	JPL	N/A	JUPITER ORBITER FLIGHT IN PLANNING STAGE	• LAUNCH WINDOW • SYNCHRONIZING RELEASE FROM ORBITER WITH IUS/PAYLOAD ORIENTATION AND IUS BURN(S) • LAUNCH THROUGH INJECTION TIMELINE IUS IGNITION TIME-CRITICAL • IUS AND PAYLOAD CHECKOUT IN ORBIT, PREINJECTION	• PAYLOAD OPERATOR PROVIDE LAUNCH WINDOW, ORBIT INJECTION REQUIREMENTS TO STS FO • STS FO/JPL JOINTLY DESIGN FLIGHT WITH EARTH ORBIT INSERTION/PLANETARY INJECTION TO MEET REQUIREMENTS • STANDARD STS/PLANETARY INTERFACES IUS CONTROL BY STS FO • ONBOARD CHECKOUT CONTROL AND PAYLOAD "GO DECISIONS" AT LAUNCH AND DEPLOY BY PAYLOAD OPERATOR
N	PLANETARY (TUG)	PIONEER	JPL	N/A	SATURN PROBE FLIGHT IN PLANNING STAGE	• LAUNCH WINDOW • SYNCHRONIZING RELEASE FROM ORBITER WITH TUG/PAYLOAD ORIENTATION AND TUG BURN(S) • LAUNCH THROUGH INJECTION TIMELINE • TUG RETRIEVAL • TUG AND PAYLOAD CHECKOUT IN-ORBIT, PREINJECTION	• PAYLOAD OPERATOR PROVIDE LAUNCH WINDOW, ORBIT INJECTION REQUIREMENTS TO STS FO • STS FO/JPL JOINTLY DESIGN FLIGHT WITH EARTH ORBIT INSERTION/, PLANETARY INJECTION TO MEET REQUIREMENTS • STANDARD STS/PLANETARY INTERFACES TUG CONTROL BY STS FO • ONBOARD CHECKOUT CONTROL AND PAYLOAD "GO DECISIONS" AT LAUNCH AND DEPLOY BY PAYLOAD OPERATOR

* The Payload Operator is assumed to be the Lead Payload Center.

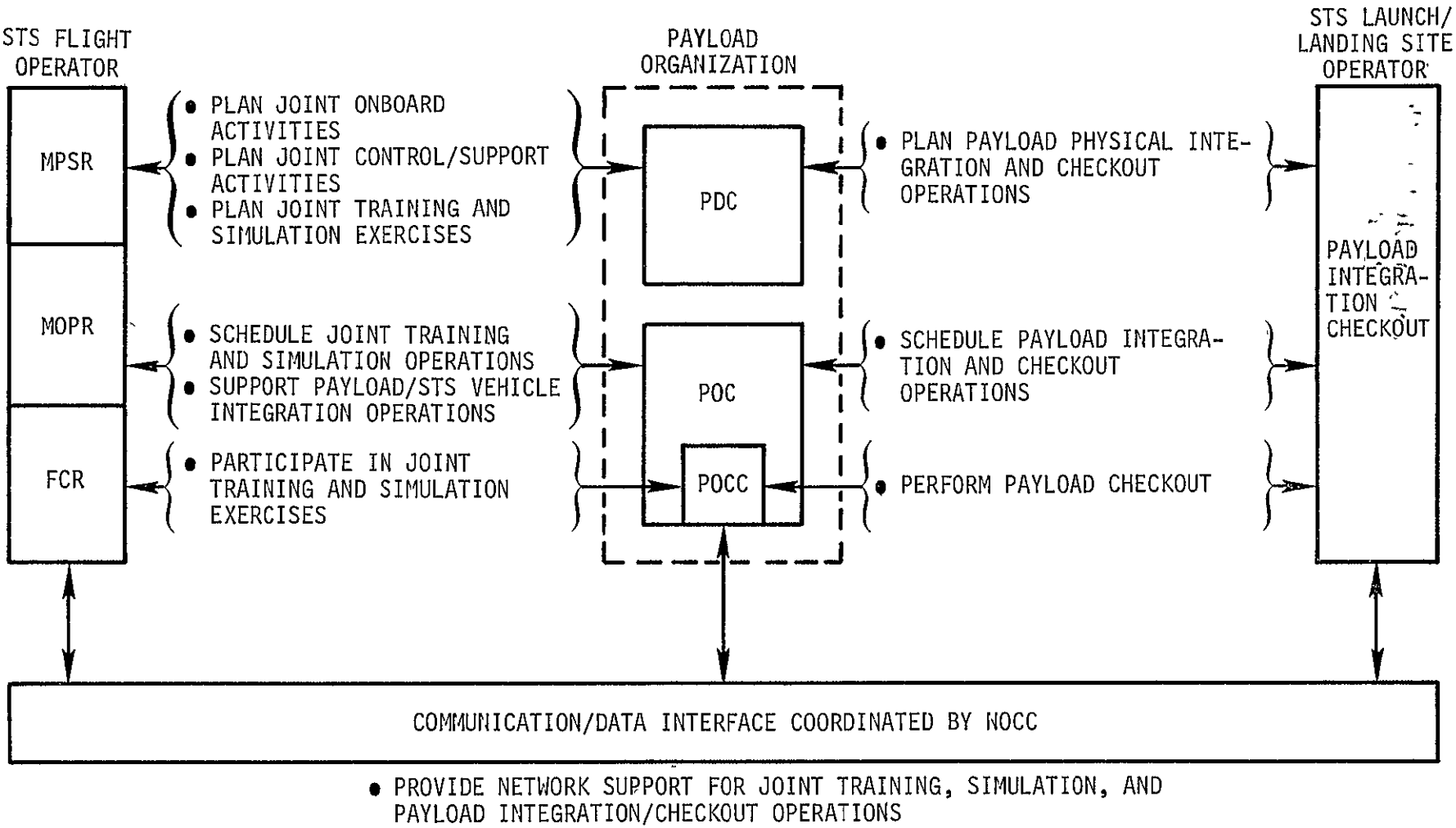

Figure 1.2-1. Joint Operational Interfaces for Planning, Training and Simulation

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- Planning of integrated real-time joint flight crew activities conducted onboard the Orbiter or Orbiter/Spacelab;
- Planning the joint or joint integrated training and simulation activities required to certify the flight crew and/or flight control/support personnel for a specific flight. (Joint activities involve STS and Payload flight crew members; joint integrated activities involve all flight crews, STS and Payload flight control and support personnel, and their respective facilities.)

Such planning interfaces must connect the designated STS Flight Control Room (FCR), and attendant Mission Planning and Support Room (MPSR) and Mission Operations Planning Room (MOPR) to the designated Payload Operations Control Center (POCC) at the responsible POC, and its attendant support facilities.

These same interfaces, plus interfaces to the simulation and/or training equipment at the facility to which a particular exercise has been assigned, and to real payload hardware at a Payload Development Center (PDC) or launch facility (if real data are to be used during the exercise), will be used to conduct the training and simulation exercises. Since one function of these exercises is to conduct end-to-end systems checkout prior to flight, the training and simulation interfaces should duplicate real-time operational network interfaces, including use of TDRSS.

1.2.5.2 Payload Organization Launch Facility Interface

A planning interface must be established between the Payload organization and the launch facility assigned for a specific flight, in order to plan joint activities required to physically integrate the payload to the STS vehicle at the launch facility. This effort must also be coordinated with the STS Flight Operator prior to integration, to assure the compatibility of the payload and the STS vehicle to which it will be attached. The actual mating will require participation of Payload personnel and STS Launch Facility personnel, with participation of other personnel as requested from the STS or Payload Operating Centers.

1.3 ACTIVITY FLOWS FOR PREFLIGHT PLANNING OF FLIGHT OPERATIONS, TRAINING AND SIMULATIONS

1.3.1 Joint Preflight Planning Flow

To assure production and implementation of the joint products and functions to be identified, preflight activities must be conducted in an orderly yet flexible manner to accommodate loading variations and other changes resulting from the maturing STS/Payload Programs. An outline of joint preflight planning activities required of the STS Flight Operator (STS FO), the Payload Operator (PLO), the Launch/Landing Site Operator (LSO) and the Network Operator (NETWORK) is presented in Figure 1.3-1, Joint Preflight Planning Flow. This figure identifies the major blocks of activities required to produce flight planning documentation and implementation packages related to a specific flight; this study is also directed at the training and simulation exercises required to train personnel for the flight, as indicated in Figure 1.3-1.

The scope of this figure includes activities originating with the assignment of a cargo or payload to a specific flight (Payload Flight Requirements Specified), until the Flight Implementation Packages are made available. The flight planning process is based on the Payload Flight Requirements, and includes several iterations of flight design and crew activity planning to finally arrive at a firm Flight Plan. A minimal set of implementation packages resulting from the planning exercise is listed in Table 1.3-1, Flight Implementation Packages. These will be exercised during the training and simulation phases of preflight operations to train flight crew and ground personnel, and to certify data for flight.

1.3.2 Identification of Major Generic Functions

This section deals with some of the major generic functions required for preflight planning of flight operations, training and simulation exercises. These functions include Planning Lead Time Analysis, Flight Requirements Definition, Flight Design, and Crew Activity Planning for STS and Payload Flight/Ground Crews, which are required for all STS flights regardless of flight objectives. The first item of discussion will be Figure 1.3-2, Preflight Planning Lead Time Analysis, which establishes a relative timeframe for preflight planning.

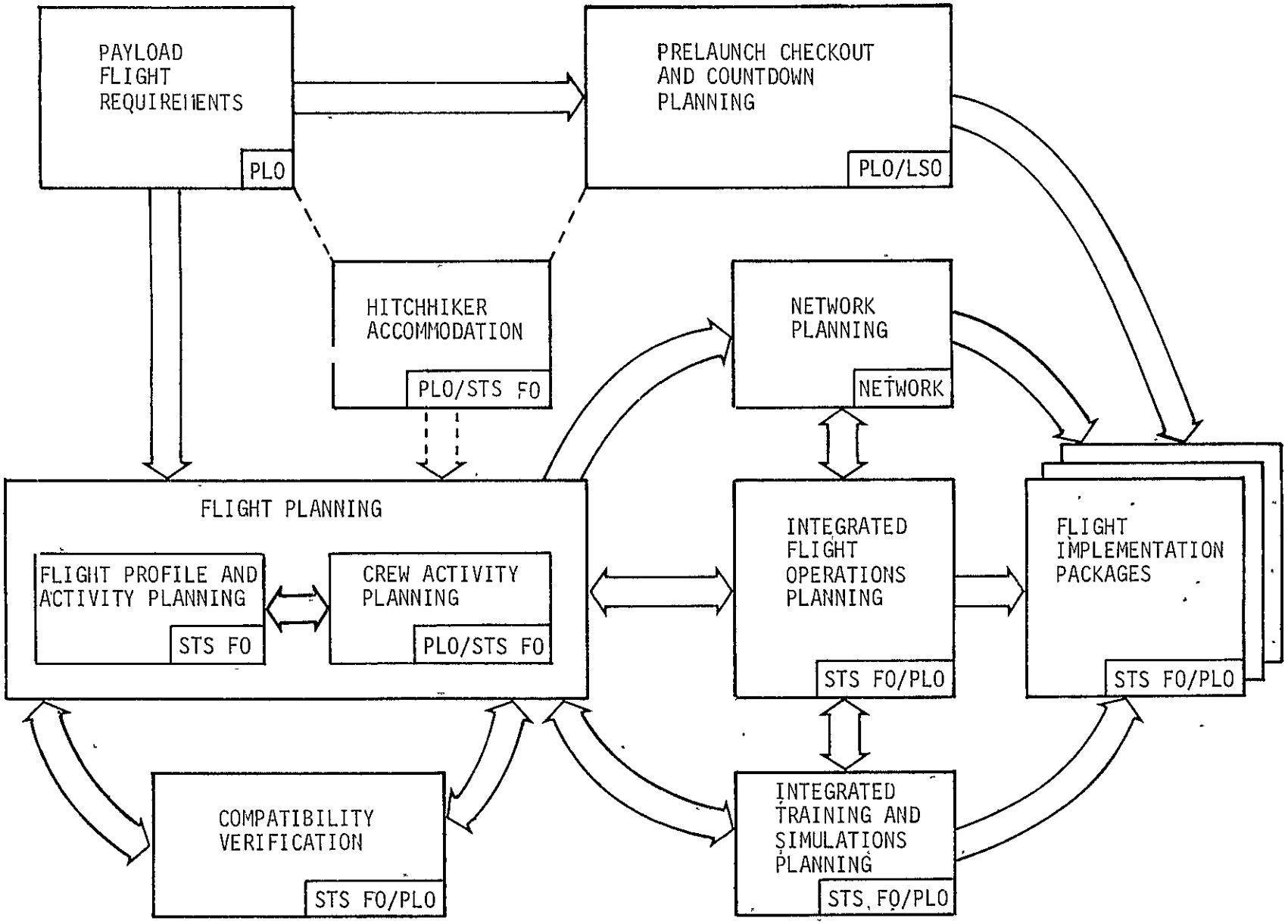

Figure 1.3-1. Joint Preflight Planning Flow

Table 1.3-1. Insert Minimal Set of Implementation Packages

ITEM	STS FLIGHT OPERATOR	PAYLOAD OPERATOR
FLIGHT DATA FILE • CREW ACTIVITY PLAN • PROCEDURES AND CHECKLISTS • REFERENCE DATA	STANDARD MODULES, UPDATES	EACH FLIGHT
FLIGHT RULES • ABORT CRITERIA • CONTINGENCY RULES • BURN RULES • EXPERIMENT OPERATION CRITERIA	STANDARD MODULES, UPDATES	EACH CARGO/PAYLOAD FLIGHT, INPUT TO STS FO
COMMAND PLAN AND PROCEDURES • STS COMMANDS • PAYLOAD COMMANDS • PROCEDURES	INTEGRATED COMMAND PLAN, EACH FLIGHT, UNTIL HANDOVER	EACH CARGO/PAYLOAD FLIGHT, INPUT TO STS FO UP TO HANDOVER
OPERATIONAL DATA BOOK • SUBSYSTEM FUNCTIONS • LIMIT CRITERIA • MASS PROPERTIES • STOWAGE CRITERIA	STANDARD MODULES, UPDATES	EACH CARGO/PAYLOAD
DATA BASES • SPECIFICATIONS • TEST RESULTS • CONFIGURATION DATA • ICD'S • SOFTWARE LOGIC	MAINTAINS STS DATA, JOINT ACCESS	MAINTAINS PAYLOAD DATA, JOINT ACCESS

Table 1.3-1. Insert Minimal Set of Implementation Packages (Continued)

ITEM	STS FLIGHT OPERATOR	PAYLOAD OPERATOR
COMMUNICATIONS AND DATA MANAGEMENT PLAN • UPLINK/DOWNLINK/GROUNDLINK WITH SOURCES, DESTINATIONS AND NODES • UPLINK/DOWNLINK/GROUNDLINK LOADS • DATA PROCESSING PLANS	STANDARD MODULES, UPDATES	STANDARD MODULE EACH OPERATOR, UPDATES EACH FLIGHT
SYSTEMS INTERFACE HANDBOOK • STS/PAYLOAD INTERFACE SCHEMATICS AND FUNCTIONAL DIAGRAMS	STANDARD MODULES, UPDATES	EACH CARGO/PAYLOAD FLIGHT
PAYLOAD HANDLING PLAN • STOWAGE LISTS • STOWAGE TIMELINES • STOWAGE PROCEDURES • LAUNCH STOWAGE PLAN • ENTRY STOWAGE PLAN • POSTLANDING PAYLOAD HANDLING PLAN	STANDARD MODULES, UPDATES	EACH CARGO/PAYLOAD FLIGHT
FLIGHT OPERATIONS INTEGRATION HANDBOOK • MCC/H-POCC FLIGHT OPERATION INTERFACES AND AGREEMENTS • INTERFACE CONTACTS, SUBJECT MATTER, TIMING • LAUNCH COUNTDOWN INTERFACE	STANDARD MODULES BETWEEN MCC-H AND EACH POCC	STANDARD MODULE, EACH POCC

1.3.2.1 Preflight Planning Lead Time Analysis (Figure 1.3-2)

Preflight planning lead time analysis consists of three major steps: (1) assignment of cargo/payload to a flight, approximately 6 to 4 years or later prior to flight; (2) refinement of Operations Requirements Analysis for the particular payload or payload grouping assigned; and (3) timing the start of Operations Planning, leading to the appropriate Flight Implementation Packages so as to optimize use of resources (mainly manpower) over the period prior to launch.

The lead times presented in Figure 1.3-2 illustrate the approximate scheduling requirements for various types of Flight Implementation Packages associated with experience and complexity factors for certain types of payload flights. The figure also illustrates the flexibility (short term planning) expected of mature STS/Payload Programs.

Payloads which fall into categories such as "new," "multiple," or "complex" payloads are expected to require a longer lead-time planning cycle, starting perhaps as early as 2 years prior to launch. This allows sufficient time for establishment of new or flight-unique implementation packages. Existing payloads for which new flight requirements have been imposed, or flight which may be resupply or repair visits-to-orbiting payloads, are expected to require an intermediate planning cycle lead time of approximately 1 year, to revise/update existing implementation packages and/or create new ones. Payloads which require only deployment, recovery, or repeat previous flights should be capable of being handled in a quick-response planning cycle of about 4 months, because the implementation packages are essentially assembled from "standardized" modules of previously flown data. Because the STS/Payload personnel are generally familiar with repeated or standardized flights, training and simulation requirements for these flights can be minimized.

Generation of flight planning documentation and flight-specific implementation packages is based on establishment of flight requirements, interface control documents (ICD's), systems and configurational analyses, flight load analysis, or other appropriate analyses performed during the period between flight assignment and the start of actual operations planning for flight.

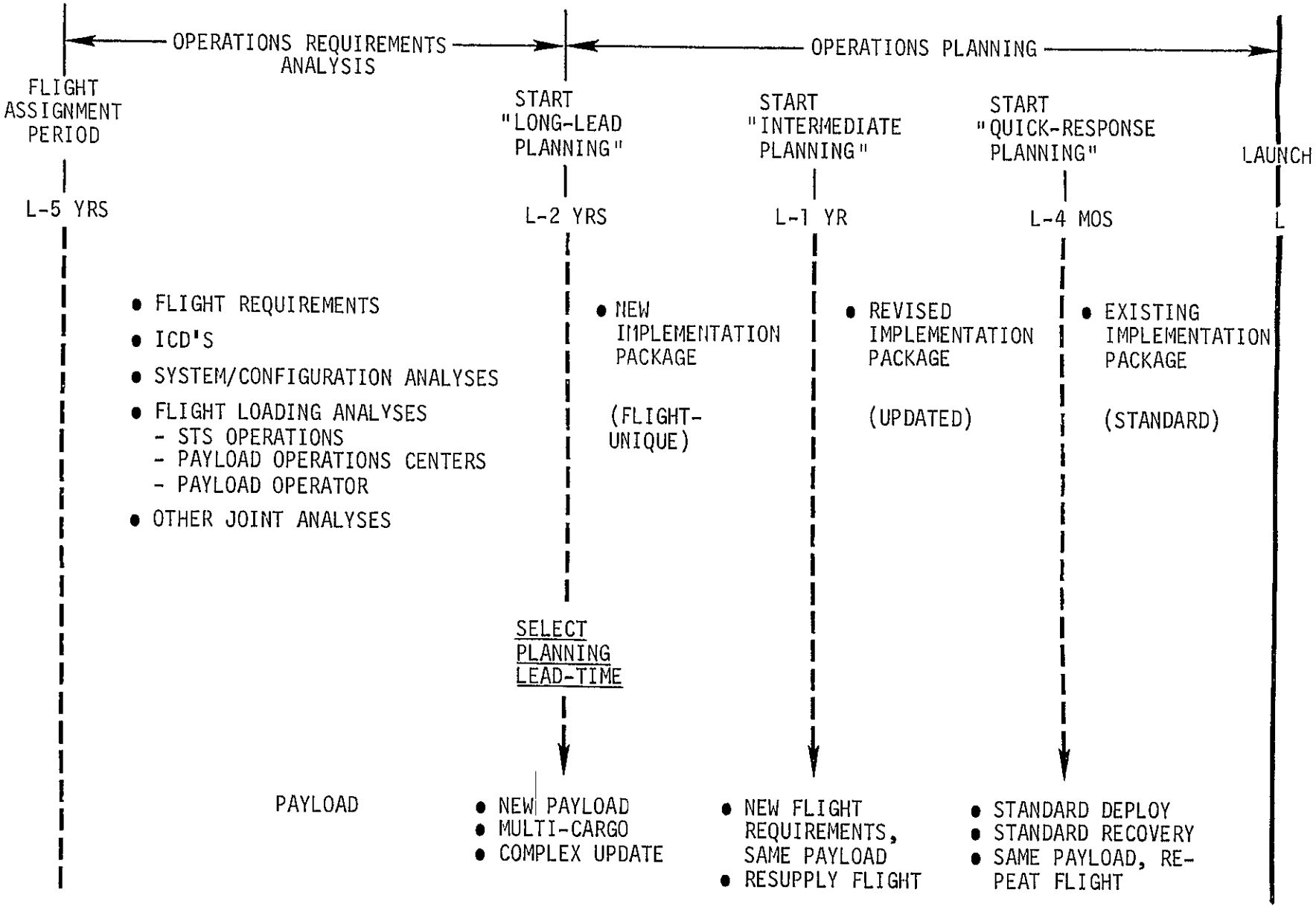

Figure 1.3-2. Preflight Planning Lead Time Analysis

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1.3.2.2 Flight Requirements Definition (Table 1.3-2)

The primary driving functions for any STS payload flight are those flight requirements defined by the Payload Operator. These requirements govern the subsequent activities of all flight-related organizations participating in the STS Program. A summary of generic flight requirements, and the organizations that would implement them is presented in Table 1.3-2, Flight Requirements Defined by Payload Operator.

1.3.2.3 Flight Design-Flow (Figure 1.3-3)

Figure 1.3-3, Flight Design Flow, identifies an approach to flight design which is intended to minimize expenditure of resources through maximum use of existing ("standardized") modules. Support requirements are categorized by impact on (1) the trajectory, (2) systems operational requirements, (3) crew activities, and (4) communications and data requirements. Comparisons are made with existing or "standard" modules in each category to filter out "unique" design requirements. These "unique" requirements establish the extent of work required to complete the flight design task for a specific payload flight. Once completed, the "unique" flight design packages are mated with "standard" or existing packages to provide an integrated flight design. It is interesting to note that different types of payload disciplines require changes in different categories of requirements, for example, Biomedical-oriented payloads impact crew activities with standard trajectory, while Earth Observations may require new trajectory pointing with same basic crew procedures.

1.3.2.4 Extent of Standardization in Joint Flight Planning Elements (Table 1.3-3)

In Table 1.3-3, the extent of standardization in flight design modules over the full spectrum of flight phases and payload categories (i.e., Spacelab, Automated Earth-Orbit and Planetary) is indicated. Clearly, there are many flight-independent standard elements, particularly during ascent (Launch through Insertion) and re-entry (Deorbit Burn through Rollout). In total, 30 out of 48 categories (62.5 percent) were judged to have the potential to be "standard" modules. Where an item was not judged to be standard, the particular variable element between payloads or flight phases is identified; e.g., "Launch Window" under "Trajectory" for all three payload categories, i.e., Spacelab, Automated Earth-Orbit, and Planetary. The many flight-independent standard elements indicate need to think in terms of a Library for Standard Modules.

Table 1.3-2. Flight Requirements Defined by Payload Operator

GENERIC FLIGHT REQUIREMENTS	IMPLEMENTER			
	PAYLOAD OPERATOR	STS FLIGHT OPERATOR	NETWORK OPERATOR	STS LAUNCH SITE OPERATOR
FLIGHT OBJECTIVES & PRIORITIES	✓	✓		
DATA AND COMMUNICATIONS REQUIREMENTS	✓	✓	✓	✓
MASS PROPERTIES	✓	✓		✓
ORBITAL PARAMETERS	✓	✓		
POINTING TARGETS	✓	✓		
EQUIPMENT OPERATIONS	✓	✓		✓
CONSUMABLES	✓	✓		✓
CREW ACTIVITIES AND PROCEDURES	✓	✓		
GROUND SUPPORT	✓	✓	✓	✓
ENVIRONMENT	✓	✓		✓
SAFETY PRECAUTIONS	✓	✓		✓
DATA PROCESSING	✓	✓	✓	
OFF-NOMINAL ALTERNATIVES	✓	✓		
	PRODUCT: PAYLOAD FLIGHT REQUIREMENTS DOCUMENT			

Table 1.3-3. Potential Extent of Standardization in Joint Flight Planning Elements

FLIGHT PHASE	EXPECTED MAJOR VARYING ELEMENT OR "STANDARD"		
	SPACELAB	AUTOMATED EARTH ORBIT	PLANETARY
PRELAUNCH THRU LAUNCH			
TRAJECTORY	LAUNCH WINDOW	LAUNCH WINDOW	LAUNCH WINDOW
SYSTEMS	MODULE/PALLET	STANDARD	STANDARD
CREW ACTIVITIES	STANDARD MONITOR	STANDARD MONITOR	STANDARD MONITOR
COMM & DATA	EXTENT OF CHECKOUT	STANDARD	STANDARD
LAUNCH THRU INSERTION			
TRAJECTORY	AZIMUTH/ALTITUDE	AZIMUTH/ALTITUDE	AZIMUTH/ALTITUDE
SYSTEMS	STANDARD	STANDARD	STANDARD
CREW ACTIVITIES	STANDARD	STANDARD	STANDARD
COMM & DATA	STANDARD	STANDARD	STANDARD
ON-ORBIT OPERATIONS			
TRAJECTORY	ATTITUDE MANEUVERS	RENDEZVOUS	TARGETING
SYSTEMS	CONSUMABLES	CONSUMABLES	STANDARD
CREW ACTIVITIES	P/L SUPPORT	RETRIEVE/SERVICE/ STANDARD DEPLOY	STANDARD DEPLOY
COMM & DATA	MAXIMUM RETURN	STANDARD	STANDARD
ENTRY THRU ROLLOUT			
TRAJECTORY	ENTRY OPPORTUNITIES	MASS PROPERTIES	STANDARD
SYSTEMS	STANDARD	STANDARD	STANDARD
CREW ACTIVITIES	STANDARD	STANDARD	STANDARD
COMM & DATA	STANDARD	STANDARD	STANDARD

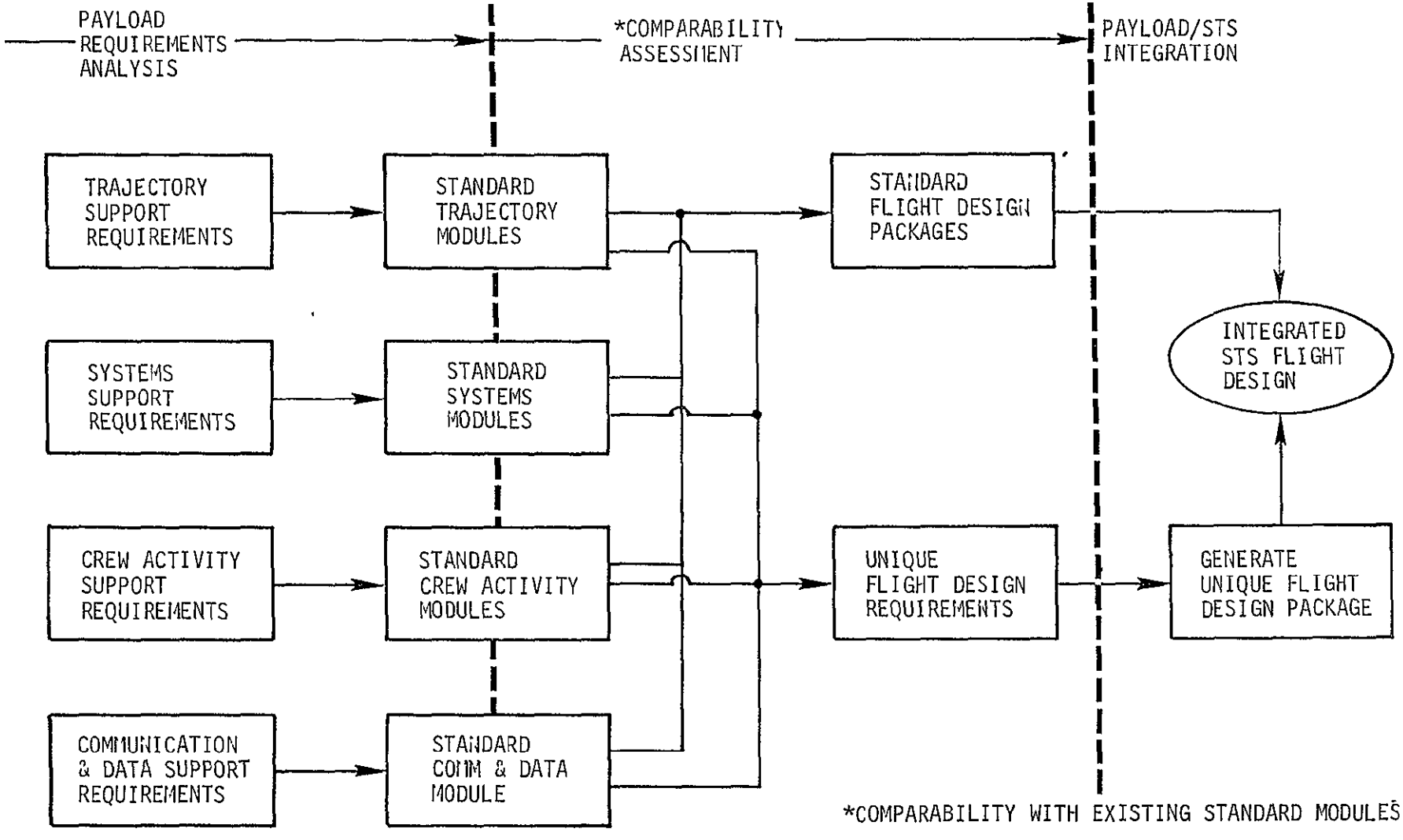

Figure 1.3-3. Flight Design Flow

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1.3.2.5 Summary of Flight Design Considerations (Table 1.3-4)

A summary of considerations applicable to flight design is presented in Table 1.3-4. As indicated, it is believed that many flight design modules, once developed, can be used over again or adapted with minimal effort to subsequent flight(s). Thus, every effort should be made to build flight design modules for repeated use, minimizing effort required to produce "unique" or flight-specific products. Standard modules are particularly applicable to launch/ascent and entry/landing phases of trajectories and to many system functions, crew activities and communications/data support activities. Unique experiment requirements will need to be iterated between STS and Payload Operators, with final trajectory work for joint flight phases generally performed by the STS Flight Operator.

1.3.2.6 Crew Activity and Flight Data Planning (Figure 1.3-4)

Another major planning function applicable to all flights, regardless of payload or flight type, is the planning of personnel activities and flight data planning required for both onboard and ground operations. These planning functions are presented, in required sequence of performance, in Figure 1.3-4, STS/Payload Personnel Activity and Flight Data Planning. This figure presents the planning and implementation activities required of both the STS and Payload Operators, during the planning phase, which result in integrated Crew Activity Plans and Flight Data File articles for onboard operations, and the complementing STS/FCR and Payload/POCC activity plans and data files to support the onboard operations. These activities are both planning functions and driving functions for simultaneous or subsequent activities, such as joint training and simulation activities.

Significant elements of Figure 1.3-4 include the "Preliminary Crew Activity Plan," the "Detailed Crew Activity Plan," and the "Final Integrated Crew Activity Plan and Flight Data Files" (STS and Payload) which result from planning, training and simulation exercises. The key input at the beginning of the activity planning cycle is the "Payload Requirements Definition" from which the "Payload Flight Requirements" and the "Trajectory Design" result. As the flight design evolves, inputs related to payload

Table 1.3-4. Flight Design Considerations Summary

- STANDARD FLIGHT DESIGN MODULES FREQUENTLY APPLICABLE
- MODULES CAN BE BASED ON PREVIOUS (E.G., OFT OR OPS) FLIGHT DESIGN
- ITERATE UNIQUE EXPERIMENT REQUIREMENTS BETWEEN STS AND PAYLOAD OPERATIONS
- LAUNCH AND ENTRY/LANDING ARE BASICALLY STANDARD PHASES
- ALLOW MAXIMUM FLEXIBILITY FOR PAYLOAD OPERATIONS PLANNING IN ON-ORBIT PHASE
- STANDARD MODULES ARE GENERALLY APPLICABLE FOR SYSTEMS, CREW ACTIVITY AND COMMUNICATIONS/DATA SUPPORT
- FOR JOINT FLIGHT PHASES, STS FLIGHT OPERATOR SHOULD PERFORM TRAJECTORY WORK INCLUDING SUPPORT TO PAYLOAD FLIGHT PLANNING AS REQUIRED

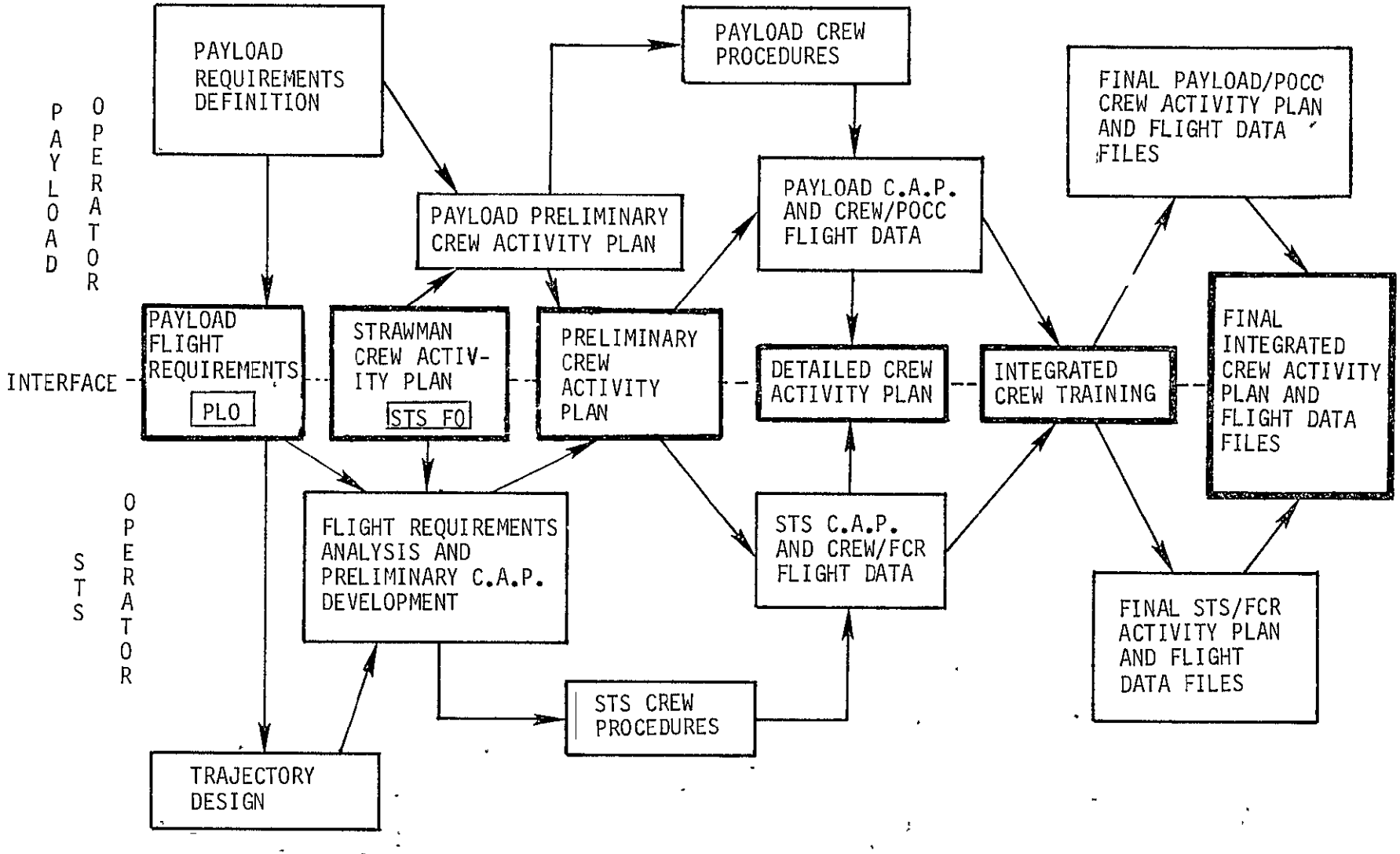

Figure 1.3-4. STS/Payload Personnel Activity and Flight Data Planning (Onboard and Ground)

and STS activities/crew procedures become more firm and more tightly integrated, yet allow some final preflight or on-orbit alterations to be incorporated. Exercise of the Detailed and Integrated Crew Activity Plans and the Flight Crew/POCC and Flight Crew/FCR interfaces during joint, integrated simulation exercises is particularly important in certification of flight crews, STS and payload support personnel, and flight data.

1.3.2.7 Joint Training and Simulation Activities (Figure 1.3-5)

The activities presented in Figure 1.3-5, Joint Training and Simulation Flows, represent the end of the preflight operations cycle. During these operations, all plans, procedures, equipment, and personnel are certified to be capable of performing the specific task related to the upcoming flight. The specific sequence of training and simulation activities, as shown in Figure 1.3-5, is:

(1) Payload Specialist familiarization and training for STS vehicle operations;

(2) STS Flight Crew familiarization and training for payload operations;

(3) Joint flight crew training and simulation exercises; and

(4) Joint, integrated flight crew and STS/payload support personnel training.

In addition to performing certification through training and simulation activities, these exercises serve to refine the contents of flight-specific products, and the execution of flight-related functions. Training and simulation exercises may be conducted simultaneously with some planning operations, the generation of products, or performance of other functions, if "standard" modules based on previous operations are used.

The sequence of training and simulation activities is important, i.e., first the Payload Specialist receives some training related to STS operations, then the STS Flight Crew receives some payload-related training, followed by joint STS/Payload crew training and integrated flight crew and ground support crew training, respectively. All training or simulation activities subsequent to Payload Specialist training on STS and STS crew training on payloads serves to reinforce the interdisciplinary knowledge of the flight crew members working together.

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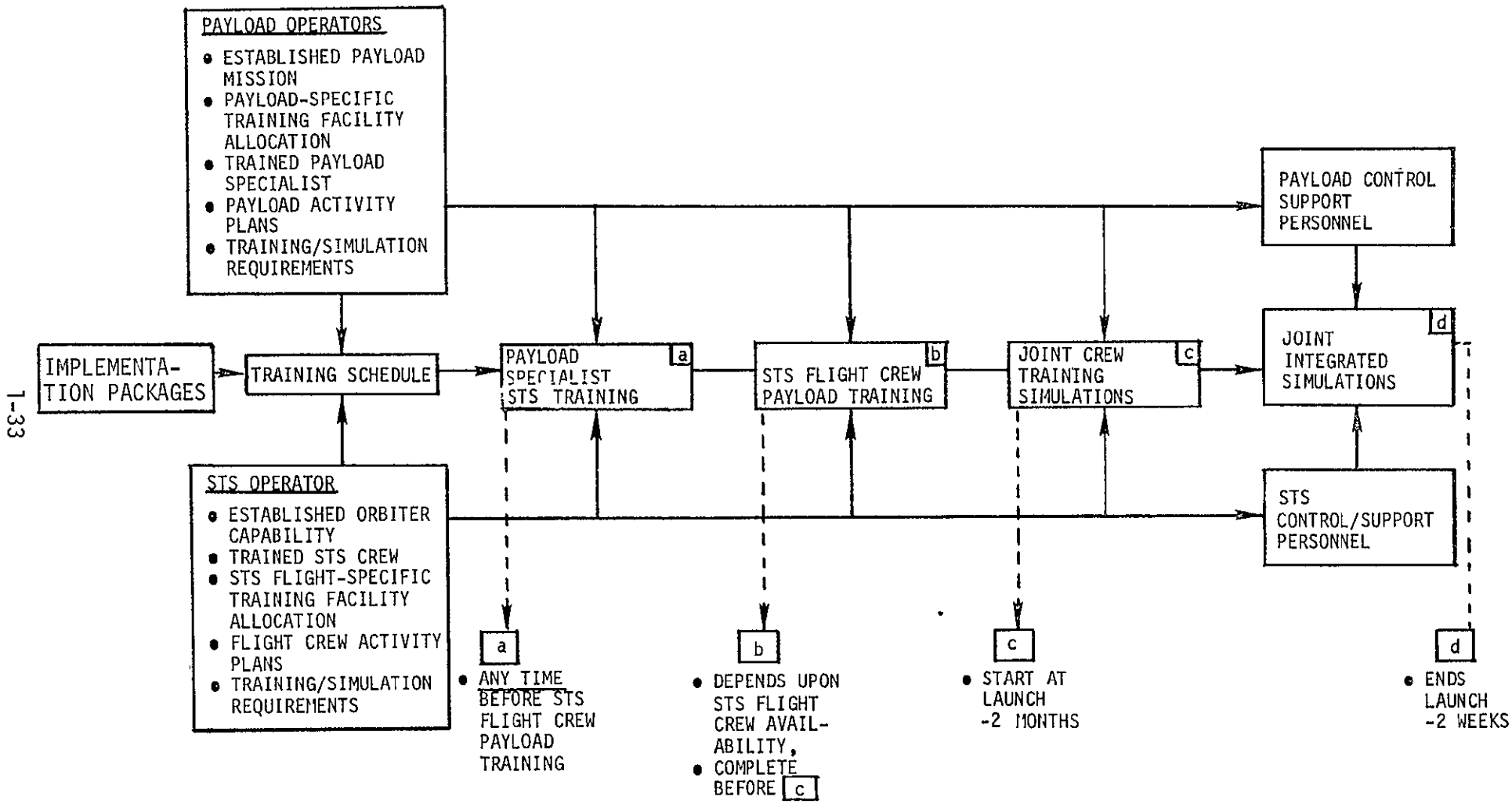

Figure 1.3-5. Joint Training and Simulation Flow

1.4 IDENTIFICATION OF PRODUCTS AND ASSOCIATION FUNCTIONS

Generic planning products are those basic products (documents, hardware, software, data) required for planning flight-specific operations necessary to accomplish a given payload objective, including flight operations, ground-based control/support efforts and the training and simulations required to certify that all STS and Payload personnel can accomplish their assigned tasks. Such training and simulation exercises also function as an operational checkout of the STS system since they will be used during actual flight operations.

The remainder of this section identifies the following: generic types of products used in preflight planning of flight operations, training and simulations; basic documents to be used by both STS and Payload organizations for planning; and joint products requiring participation of both Operators. The basic documents may be generated by any STS-related organization for use by all STS participants, and may require participation of more than one organization. Joint documents specifically require participation of both the STS Flight and Payload Operators, and may apply to one or more payload flight types.

1.4.1 Generic Products

Certain types of products are required to conduct any preflight planning operations, whether specifically directed at payload planning or at STS activities supporting payload operations. Table 1.4-1, Generic Planning Products, presents a list of generic products required for preflight planning, training and simulations; identifies the function of each type of product; and cites examples applicable to such planning activities.

All products used in planning operations serve more than the minimum functions cited in the table; most products perform multiple functions, and are referenced to other related products. For example, the Crew Activity Plan contains timelines, procedures, constraints and guidelines, trajectory data, and other information related to a flight; however, this document is not the primary source of all such information.

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Table 1.4-1. Generic Planning Products

GENERIC PRODUCT	PRODUCT FUNCTION	EXAMPLE(S)
Requirements	Defines objectives of a specific operation or group of operations which must be met or achieved in order to successfully attain a specific goal	Payload Flight Requirements
Rules	Defines policies regarding certain specific areas of concern	Flight Rules
Constraints and Guidelines	Defines certain operational or procedural limits which must be adhered to during planning or implementation of certain operations or activities	Trajectory Operations Constraints and Guidelines
Plans	Defines a specific method of implementing conceptual or actual operations in order to meet requirements or objectives previously specified	Crew Activity Plan; Communications and Data Operations Plan
Techniques	Defines specific methods of accomplishing certain activities or objectives based on experience or analytical design	Flight Techniques, Crew Activity Planning Techniques
Procedures	Defines specific time-related activities required to accomplish certain tasks or operations	Integrated Flight Procedures; Orbiter System Operations Procedures
Guide/Users Guide	Defines operations required for utilization of a system or product, and the capabilities of that system or product	Users Guide to STS Flight Planning; Flight Rule Preparation Guide

Table 1.4-1. Generic Planning Products (Continued)

GENERIC PRODUCT	PRODUCT FUNCTION	EXAMPLE(S)
Checklists	Abbreviated crew procedures related to onboard systems operation during orbital operations of an STS vehicle or Payload	GN&C Checklist, Experiment Checklist
Update Books	Contains data forms for recording information required to update the Flight Data File (or other onboard textual data; i.e., decals) during a flight	Update Book
Criteria	Defines capabilities of systems, equipment and personnel; and establishes selection and utilization limits, to which the personnel or materials will be expected to perform	Shuttle EVA Description and Design Criteria
Specifications	Defines operational requirements and physical properties of equipment, hardware or other materials	Flight Data File Design Specifications
Standards	Defines size, format, material properties, and constraints applicable to materials used for planning purposes	Flight Data File Preparation Standards
Handbooks	Repository for data or information, usually related to a specific system, piece of equipment, hardware, or software	Crew Equipment Handbook, Payload Support Systems Handbook
Manuals	Defines procedures to be used in certain situations by ground personnel; not related to flight operations	Orbiter Crash and Rescue Information Manual; Maintenance Manuals

Table 1.4-1. Generic Planning Products (Continued)

GENERIC PRODUCT	PRODUCT FUNCTION	EXAMPLE(S)
Data Books	Authenticated data or information related to the operation of a system or group of systems (data usually maintained current and authenticated by responsible Subsystem Manager)	Shuttle Operational Data Book
Data Base	Library of textual data, or data retained in electronic memory devices, used in providing common data to organizations with related interests. Electronically stored data may be accessible at more than one location.	Payload Configuration Data; Mission Data; Document References; Other Categories
Schedules	Defines sequence and timing requirements necessary to accomplish a sequence of events, in an orderly manner, to meet previously specified objectives	Training Schedule
Definitions	Defines needs for specific system or article of hardware or software	Maneuver Option Processor Definition
Reports	Status summary of progress related to a specific activity, program, or operation	Training Status Report
Minutes	Specific record of meeting actions required to track progress of problems and action items	Flight Operations Panel (FOP) Minutes
Scripts	Predetermined sequence of events designed to train, simulate, or test certain aspects of the STS Program	Simulation Scripts, Training Scripts

Table 1.4-1. Generic Planning Products (Continued)

GENERIC PRODUCT	PRODUCT FUNCTION	EXAMPLE(S)
Materials	Textual data and hardware required to supplement training facilities, to assist in accomplishing certain training objectives	Classroom Training Material
Packs	Textual data and hardware assembled into a unit for use in trainers or simulators, to accomplish specific training tasks	Specialized Training Packs
Annex	A separate document complementing and related to a specific document already existing; annexes usually contain information related to a specific application of concepts outlined in the primary document, such as a Baseline Operations Plan	Payload Support Operations Annex to BOP; DOD Annex to BOP, Etc.

1.4.2 Flight-Specific Application of Generic Products to Payload Categories

Of those generic planning products cited in Table 1.4-1, very few are unique to a specific flight. The generic products can generally be placed in three categories: New or unique products; flight-type products utilizing modular updates; and basic documents whose revisions are not based on flight-related operations. The breakdown of generic products into these categories is as follows:

- New or unique (flight-specific) products
  - Checklists
  - Update Books
  - Requirements
  - Plans
  - Schedules
  - Reports
  - Flight-Related Meeting Minutes
- Flight-type specific products utilizing modularized sections or updates
  - Specifications
  - Techniques
  - Procedures
  - Constraints and Guidelines
  - Training and Simulation Scripts
- Basic documentation products
  - Standards
  - Criteria
  - Guides/Users Guides
  - Manuals
  - Handbooks
  - Data Books
  - Data Base
  - Rules
  - Definitions
  - Training Materials

While certain specific products are unique to some STS/Payload flights, all STS/Payload flight operations require documentation of the types cited above and in Table 1.4-1. As the STS Program matures, efforts should be undertaken to reduce the quantity of products required to support a flight by combining certain products, or by eliminating products no longer required. Emphasis should be directed at modularization of all products so that data required to support a flight can be assembled from existing information as much as possible, rather than the same data republished for every flight.

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1.4.3 Documentary Product Base

1.4.3.1 STS Program Operations Product Base

The products presented in Table 1.4-2, Basic STS Program Products, are those items currently being generated or maintained as products necessary to the STS Program and are identified by their specific titles as applied by the STS organization. These STS products provide an indication of corresponding products needed in support of payload flight operations. Corresponding titles of equivalent documents for the Payload organization have not been identified.

The STS Flight Operator products are produced on two levels: products approved at the Directorate level, which deal with matters relevant to a specific discipline; and products approved at Division level, which deal with segments or subsegments of a Directorate discipline. Other products in the product base are generated and approved outside the STS Flight Operator organization, such as Network or Launch/Landing Range Products. Supportive to all of the other products are those key products approved at the Program level, which may, e.g., justify or delegate authority to undertake an operation.

The products generated by these organizations fall into three major categories:

- Requirements documents, which specify deliverables (hardware, software, or textual), facilities, systems, or personnel needed to perform a task or accomplish an objective;
- Policy documents, which specify how decisions will be made, or operations conducted; and
- Implementation documents, containing technical data, plans, or schedules required to perform a task, phase of operations, activity, or the generation or maintenance of a product.

Some of these products are unique to the STS organization, such as the MCC Requirements document; however, the Payload organization involved will need an equivalent product. This table includes all identifiable products, to be used by STS Flight Operator/Payload Operator individually or jointly, which contain pertinent data, including some Payload-related data as determined by the STS Flight Operator.

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Table 1.4-2a. Basic STS Program Products - Directorate Level

STS FLIGHT OPERATOR DIRECTORATE-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
REQUIREMENTS		
SHUTTLE SYSTEM/SOFTWARE CONSOLE CONFIGURATION REQUIREMENTS • Flight-specific configuration of operating console	Flight-specific	
PAYLOAD SUPPORT SYSTEMS ONBOARD SOFTWARE REQUIREMENTS • Payload support systems management and display requirements	Payload-specific	✓
ONBOARD CREW EQUIPMENT OPERATIONS REQUIREMENTS • Defines operating procedures for onboard crew equipment • May be individual documents covering specific pieces of equipment	Publish as required	✓
MCC REQUIREMENTS • Defines ground systems required to support flight operations in detail	One document - revise as required	✓
STDN/TDRSS REQUIREMENTS • Defines ground command/ control operations • Covers network and TDRSS	Flight or flight-type specific	✓
SHUTTLE GENERALIZED DOCUMENTATION PROCESSOR (GDP) • Application of GDP to product generation, management and publication	One document - revise as required	

Table 1.4-2a. Basic STS Program Products - Directorate Level (Continued)

STS FLIGHT OPERATOR DIRECTORATE-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
REQUIREMENTS (Continued)		
TRAINING SYSTEM REQUIREMENTS • Classroom training requirements • Trainer system requirements • Simulator system requirements • Specialized crew equipment training requirements	Multiple documents published once - revise as required	✓
PAYLOAD FLIGHT REQUIREMENTS • Specifies flight objectives and priorities which are basis for: - data and communications - mass properties - orbital parameters - pointing targets - equipment operations - consumables support - crew activities and procedures - ground support - environment - safety - data processing - contingencies and alternatives	Flight-specific	Primary document
DATA BOOK		
SHUTTLE OPERATIONAL DATA BOOK • Contains Orbiter vehicle data to subsystem level - mainly configuration, mass properties functional data and operating limit data	Orbiter-specific	Payload-specific applicable

Table 1.4-2a. Basic STS Program Products - Directorate Level (Continued)

STS FLIGHT OPERATOR DIRECTORATE-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
POLICIES		
PROGRAM SUPPORT AND MANAGEMENT PLAN • Defines major activities and Directorate products • Outlines support for assigned programs	Annual	✓
BASELINE OPERATIONS PLAN • Conceptual approach to spacecraft and ground support operations • Organizational responsibilities	One basic document	(Annex)
DATA BASE DEVELOPMENT AND INTEGRATION PLAN • Defines baseline concept, procedures and responsibilities • Covers development, maintenance and utilization	One document - revise as required	(Payload Applicable Inputs)
GROUND SYSTEM REQUIREMENTS PREPARATION • Defines responsibility, format and technique for generating ground system requirements	One document	✓
FLIGHT RULES • Defines flight policies and priorities regarding crew safety and mission objectives	Flight-specific	✓

Table 1.4-2a. Basic STS Program Products - Directorate Level (Continued)

STS FLIGHT OPERATOR DIRECTORATE-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
POLICIES (Continued)		
LAUNCH RULE INPUTS • Defines requirements/capabilities which must be met to provide a launch commit	Flight-specific	✓
PAYLOAD SUPPORT SYSTEM USERS GUIDE • Provides user visibility into operations, functions and constraints of the STS vehicles and system	One document - revise as required	
CREW PROCEDURES MANAGEMENT PLAN (CPMP) • Defines management control for procedure development, control and integration	One document - revise as required	✓
CREW PROCEDURES DEVELOPMENT PLAN (APPENDIX TO CPMP) • Defines specifications, validation requirements and documentation requirements	One document - revise as required	
FLIGHT DATA FILE DEFINITION • Defines articles to be carried onboard and utilized during flight	One document - Flight-specific addendums	✓
USER'S GUIDE TO STS FLIGHT PLANNING • Defines interface between STS Flight Operator and STS User for flight activity planning	One document	

Table 1.4-2a. Basic STS Program Products - Directorate Level (Continued)

STS FLIGHT OPERATOR DIRECTORATE-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
POLICIES (Continued)		
TRAINING MANAGEMENT PLAN • Defines management control processes for training development, conduct, evaluation and reporting	One document	✓
TRAINING CONCEPTS • Defines conceptual approach to preflight training, including generic facility and schedule concepts	One document - revise as required	✓
TRAINING PROGRAM AND SYLLABUS • Defines detailed training required for operational tasks	Multiple documents	✓
PROCEDURES DECAL IMPLEMENTATION PLAN • Defines mechanism for implementating procedural decals on flight equipment	One document	
TECHNICAL DATA/PLANS/SCHEDULES		
FLIGHT TECHNIQUES • Defines techniques applicable to flight phases, types, or activities • Provides forum for STS Flight and Payload Operators to develop joint, integrated operational techniques	Continuous revision	✓

Table 1.4-2a. Basic STS Program Products - Directorate Level (Continued)

STS FLIGHT OPERATOR DIRECTORATE-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
PRODUCT SCHEDULES • Defines schedule/task deliverable tradeoffs within an organization	Bimonthly	✓
REFERENCE MISSION DOCUMENTS • Defines typical flight timelines; used for training and simulations	Multiple documents	✓
FLIGHT DATA FILE (FDF) • Basic checklists • Integrated checklists • Reference data • Hardware	Multiple documents	✓
SUMMARY/DETAILED CREW ACTIVITY PLANS • Identifies preliminary and detailed activities required of the crew during a flight	One each (minimum) per flight	✓
SHUTTLE EVA DESCRIPTION AND DESIGN CRITERIA • Establishes baseline criteria for planning EVA crew activities and support	One document - update as required	
ORBITER CRASH AND RESCUE INFORMATION MANUAL • Defines ground rescue procedures to be implemented in case of a crash, or if crew safety is in danger after landing	Basic document plus site- and payload-dependent annexes	✓

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Table 1.4-2a. Basic STS Program Products - Directorate Level (Continued)

STS FLIGHT OPERATOR DIRECTORATE-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
FLIGHT DEBRIEFING PLAN • Defines emphasis, schedule, and certain specific debriefing questions	One document	✓
FLIGHT DEBRIEFING REPORT • Final report of flight crew/ flight controller performance submitted to program management	Flight-specific	✓

Table 1.4-2b. Basic STS Program Products - Division Level

STS FLIGHT OPERATOR DIVISION-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
REQUIREMENTS		
MCC CREW EQUIPMENT CONSOLE CONFIGURATION REQUIREMENTS • Flight-specific configuration of MCC operations/support equipment	Flight-specific	✓
POLICIES		
FLIGHT DATA FILE PREPARATION STANDARDS • Defines format, size, material specifications and constraints applicable to onboard documentation	One document	
FLIGHT DATA FILE DISTRIBUTION AND LOGISTICS CONTROL PLAN • Defines controls for updating FDF articles in trainers, simulators, classrooms, and at other facilities	One document - revise as required	✓
FLIGHT DATA FILE DESIGN SPECIFICATIONS • "Hardware" description of FDF articles • Lists acceptable fabrication materials • Used for stowage/mass property study	One document - revise as required	

Table 1.4-2b. Basic STS Program Products - Division Level (Continued)

STS FLIGHT OPERATOR DIVISION-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
POLICIES (Continued)		
SIMULATION EVALUATION PLANS • Defines test objectives, simulator configuration, run requirements, schedule, and participation requirements	Flight-specific	✓
TRAINING DATA FILE DEFINITION • List and description of training materials and documents, equivalent to flight-type material and documents onboard the orbital vehicle	One document set - revise as required	✓
CLASSROOM TRAINING MATERIALS DEVELOPMENT GUIDE/PLAN • Outlines levels of training, scope, emphasis, validation and material maintenance requirements	One document	
MCC DATA FORMAT AND CONSOLE STANDARDS • Establishes standards for console display and control configurations	One document - revise as required	POCC Equivalent
FLIGHT RULE PREPARATION GUIDE • Defines function, authority, technique, and interface requirements for flight rule development	One document	
RANGE SAFETY INTERFACE PROCEDURES • Defines participation in range safety checks and operations	One document per launch site - revise as required	

Table 1.4-2b. Basic STS Program Products - Division Level (Continued)

STS FLIGHT OPERATOR DIVISION-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
FLIGHT OPERATIONS PLANNING CONSTRAINTS AND GUIDELINES • Defines constraints/guidelines related to: - communications, data and network operations - trajectory - spacecraft systems - flight crew - payload support systems	One document under continuous revision	
FLIGHT OPERATIONS INTEGRATION HANDBOOK • Defines operational interfaces - within NASA/JSC - between NASA/JSC and other STS participants • Emphasis on flight controller/ POC real-time operations	Flight-type specific	✓
COMMUNICATIONS AND DATA OPERATIONS PLAN • Establishes nominal and contingency information management plan	Flight-specific	✓
CONSOLE HANDBOOKS • Defines layout, capabilities, and maintenance requirements for each flight control/ support console	One document per console - revise as required	✓

Table 1.4-2b. Basic STS Program Products - Division Level (Continued)

STS FLIGHT OPERATOR DIVISION-LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
FLIGHT RULES RATIONALE • Defines reasons, considerations, and tradeoffs used in establishing specific flight rules	Flight-type specific - revise as required	✓
SHUTTLE SYSTEMS HANDBOOK • Primary source of systems data during real-time operations; used as reference when developing work-around procedures	Orbiter-specific	
CREW SYSTEMS HANDBOOK • Reference source for systems data on crew equipment exclusive of Orbiter vehicle	One document	✓
PAYLOAD SUPPORT SYSTEMS HANDBOOK • Reference source for systems data on payload-related STS equipment, especially Spacelab and IUS	Configuration specific	✓
SHUTTLE FLIGHT SOFTWARE HANDBOOK • Reference source for Orbiter software data	Flight software program specific	
SPACELAB PAYLOAD SUPPORT SYSTEMS FLIGHT SOFTWARE HANDBOOK • Reference source for Spacelab computer software data	Flight software specific program	✓

Table 1.4-2b. Basic STS Program Products - Division Level (Continued)

STS FLIGHT OPERATOR DIVISION LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
ORBITER SYSTEMS OPERATIONS PROCEDURES • Defines systems moding, sequencing, control, management, and operation of Orbiter systems, for nominal and contingency operations	One document per system, per vehicle, with revisions	
CREW SYSTEMS OPERATING PROCEDURES • Basic operating procedures of equipment described in Crew Systems Handbook	One document - revise as required	✓
PAYLOAD SUPPORT SYSTEM OPERATIONS PROCEDURES • Defines systems moding, sequencing, control, management, and operations of payload support systems	System specific	
ORBITER CONSUMABLES MANAGEMENT PLAN • Defines utilization of Orbiter systems consumables on a flight-specific basis • Primary reference for flight-specific flight rules, flight plan, and flight data file	Flight specific	✓
INTEGRATED FLIGHT PROCEDURES • Self-contained procedural sequences covering major Crew Activity Plan elements	Flight-type specific	✓

Table 1.4-2b. Basic STS Program Products - Division Level (Continued)

STS FLIGHT OPERATOR DIVISION LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
CREW ACTIVITY PLANNING TECHNIQUES • Defines techniques and guidelines for scheduling in-flight crew activities	One document	
SIMULATION EVALUATION REPORTS • Record and evaluation of results of simulator exercises	Simulation exercise specific	✓
FLIGHT CREW HANDBOOK • Extracts of training and operational data tailored to flight crew usage for self-study and training exercises	As required	✓
CLASSROOM LESSON PLANS • Formal outline of flight-specific classes	Flight-specific	✓
TRAINER LESSON PLANS AND MATERIAL • Includes objectives, key points, sequence of operations and materials required for training exercises	As required	✓
CLASSROOM TRAINING MATERIAL • Materials required to support classroom training (handouts, slides, tapes, etc.)	Class-specific	✓

Table 1.4-2b. Basic STS Program Products - Division Level (Continued)

STS FLIGHT OPERATOR DIVISION LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
SPECIALIZED TRAINING PACKS • Special training data or equipment required to train for survival, emergency egress, and specialized equipment or procedure training	As required	✓
SIMULATION PROCEDURES HANDBOOK • Defines simulation instructor interfaces and procedures related to conduct of a simulation	One document - revise as required	✓
SIMULATION CHECKOUT PLAN • Defines conditions and procedures utilized to verify simulation system readiness, and for operational support	As required	✓
SIMULATION SCRIPTS • Defines specific individual simulated flight profiles for crew and/or flight controller training	Flight-specific	✓
TRAINING SCHEDULES • Defines time, location, scope and participation required for training and simulation exercises	Weekly	✓

Table 1.4-2b. Basic STS Program Products - Division Level (Continued)

STS FLIGHT OPERATOR DIVISION LEVEL PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
TECHNICAL DATA/PLANS/SCHEDULES (Continued)		
TRAINING PROGRESS REPORTS • Status of flight crew/flight controller training and simulation progress	Monthly	✓
COMMAND PLAN AND PROCEDURES • Outlines specific command sequence to STS and Payload prior to deployment	Flight-specific	✓
SYSTEMS INTERFACE HANDBOOK • Contains STS/Payload interface schematics and functional diagrams for training or operational use	Payload configuration specific - update as required	✓

Table 1.4-2c. Basic STS Program Products - Network and Launch/Landing Range

NETWORK AND LAUNCH/ LANDING RANGE PRODUCTS	PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
SUPPORT INSTRUMENTATION REQUIREMENTS DOCUMENT (SIRD) • Establishes network requirements for STS and Payload support	Program oriented; flight-specific updates	✓
NETWORK SUPPORT PLAN (NSP) • Implementation of SIRD requirements. Item-by-item response to SIRD	Program oriented; flight-specific updates	✓
NETWORK OPERATIONS SUPPORT PLAN • Identifies NASCOM, STS Flight Operator and Payload Operator interfaces with network, contains detailed instructions for NOCC, NASCOM and all ground stations	Flight-specific	✓
NETWORK TEST PLAN • Defines RF and data compatibility tests, end-to-end checkout procedures, and Payload/Network RF tests	Flight-specific	✓
PROGRAM REQUIREMENTS DOCUMENT (PRD) • Specifies Launch/Landing range requirements in accordance with UDS formats • From Project to DOD Director of Range Operations	STS Program for each site - update as required	✓

Table 1.4-2c. Basic STS Program Products - Network and Launch/Landing Range (Continued)

NETWORK AND LAUNCH/ LANDING RANGE PRODUCTS	STS PRODUCTION REQUIREMENT/ SCHEDULE	PAYLOAD EQUIVALENT OR PAYLOAD CONTRIBUTION REQUIRED
PROGRAM SUPPORT PLAN (PSP) • Answers PRD item-by-item • From DOD Director of Range Operations to Project	Program oriented; flight-specific updates	✓
OPERATIONS REQUIREMENTS • Flight-by-flight requirements at launch/landing range	Each flight	✓
OPERATIONS DIRECTIVE • Implements OR item-by-item	Each flight	✓

1.4.3.2 Payload Program Operations Product Base

Although Payload Program products have not been specifically identified by product titles, some products equivalent to STS Program products have been identified; these products are identified by check marks (√) in the right-hand column of Table 1.4-2, under the heading "Payload Equivalent or Payload Contribution Required."

The Payload Product base is smaller than the STS Product base for several reasons:

- The STS Operator has sole responsibility for some documents because of their exclusive position of relating in a similar manner to all Payload Operators (e.g., "Crew Integration Plan"), or because of their position of service to all Users (e.g., "Users Guide to STS Flight Planning").
- Some documents do not require duplication (e.g., "STS Flight Rules").
- Some Payload Products will be annexed to existing STS Products (e.g., BOP Annex).

In any case, the basic payload product base, for internal or joint use, is partly identified in the right-hand column of Table 1.4-2.

Referring back to Section 1.4.2, not all of these products are republished or updated for each flight. Many are published only once, others are Payload-specific, requiring updates only as the Payload changes. Those documents which are Payload-flight-specific are usually easily adapted to modularization, wherein a new flight may be composed of segments of previously-flown flight phases (even from a different Payload organization), with time-related data adapted for the new flight.

Documentation products will be further simplified through use of the Generalized Documentation Processor (GDP) and a common data base to maximize integrated planning and data retention for generation of flight-specific products. Publication and distribution efforts can be reduced by generation, management and circulation of products via the GDP system, resorting to publication only when a product is approved in final form and flight is imminent.

1.4.4 Joint Planning Products Common to All Payload Flight Types

Of all generic products and basic documents specified above, certain products (or functions within those products) may be regarded as joint products by their contents or their utilization. Such products or functions may be required for the planning of flight operations and/or planning of ground-based control/support efforts; and/or for the planning and implementation of training and simulation exercises necessary to certify STS personnel to perform specific activities related to a particular Payload flight. A basic list of such payload products is presented in Table 1.4-3, Joint Planning Products Common to All Payload Flight Types.

In addition to the basic list of jointly used planning products, the table presents the primary function accomplished by each product; the planning application of each product with respect to flight operations, or training and simulation exercises; and the party currently responsible for publication of the product. The table does not contain products normally used internally by either organization, although some internal products may be used informally by the other organization.

These products (or segments of these products) in Table 1.4-3 are the only ones required for basic planning of flight operations, ground-based control/support operations, training and simulations. For an example, some communications requirements are specified in the STDN/TDRSS Requirements document as applied to STS vehicle-only operations (post-deployment or pre-retrieval), payload-only support operations, and joint support operations (pre-deployment or post-retrieval). The segment of primary interest for planning purposes is the communications requirements for joint operations; the other data in the document are useful primarily to only one Operator or the other, and jointly only on a very limited basis, such as to avoid simultaneous operations.

Similarly, both Operators may publish segments of a product, such as the Flight Data File (FDF). The Payload Operator is responsible for all payload checklists, procedures, and all other payload-related documents; the STS Operator is responsible for all other FDF articles. Together, they are combined to form a joint product, used for planning and executing joint

Table 1.4-3. Joint Planning Products Common to All Payload Flight Types

JOINT PLANNING PRODUCT	FUNCTION	PLANNING JOINT FLIGHT OPERATIONS	PLANNING JOINT TRAIN/SIM EXERCISES	PUBLISHER
Baseline Operations Plan	Defines conceptual approaches to spacecraft and ground support operations, including administrative and organizational responsibilities		✓	Principal Document- STS Operator Annexes- Payload Operators
Mission Requirements	Defines Payload flight objectives and requirements applicable to a specific payload	✓	✓	Payload Operator
STDN/TDRSS Requirements	Defines STDN/TDRSS support required for communications and data management for a payload flight	✓	✓	STS Operator
Flight Operations Integration Handbook	Establishes guidelines for interface procedures between MCC-H and elements of other support centers, particularly for real-time operations	✓	✓	STS Operator
Communications and Data Operations Plan	Establishes nominal and contingency information management procedures	✓	✓	STS Operator
Range Safety Interface Procedures	Identifies prelaunch range safety checks and real-time flight crew range safety procedures	✓	✓	STS Operator

Table 1.4-3. Joint Planning Products Common to All Payload Flight Types (Continued)

JOINT PLANNING PRODUCT	FUNCTION	PLANNING JOINT FLIGHT OPERATIONS	PLANNING JOINT TRAIN/SIM EXERCISES	PUBLISHER
Detailed Crew Activity Plan	Defines activities required to allow crew to accomplish planned flight objectives		✓	STS Operator
Crew Procedures Management Plan	Defines management required to develop, control and integrate STS and Payload procedures, and the required interface	✓	✓	STS Operator
Flight Data File	Onboard equipment and textual data required for flight-specific operations; includes: Basic Checklists Integrated Checklists Reference Data Hardware		✓	STS Operator, Payload Operator See Note (1), page 1-66
Integrated Crew Activity Plan	Defines major integrated crew activity plan events		✓	STS Operator
Crew Equipment Flight Rules	Defines operating policies for onboard utilization of STS or Payload crew equipment		✓	STS Operator
Crew Integration Plan	Identifies crew role in hardware tests and checkout, including schedule		✓	STS Operator

Table 1.4-3. Joint Planning Products Common to All Payload Flight Types (Continued)

JOINT PLANNING PRODUCT	FUNCTION	PLANNING JOINT FLIGHT OPERATIONS	PLANNING JOINT TRAIN/SIM EXERCISES	PUBLISHER
Training Schedules	Defines daily schedule of flight crew and flight control/support training/simulation activities		✓	STS Operator, Payload Operator - See Note (2) page 1-66
Training Program and Syllabus	Defines detailed training requirements, schedule, materials, and identification of training source		✓	STS Operator, Payload Operator - See Note (2) page 1-66
Classroom Lesson Plans	Formal outline of individual classes, including objectives, sequence and specific materials to be used		✓	STS Operator, Payload Operator - See Note (2) page 1-66
Trainer Lesson Plans and Material	Defines objectives, sequences, and materials required for training, particularly in 1-G trainers		✓	STS Operator, Payload Operator - See Note (2) page 1-66
Simulation Scripts	Defines specific simulated flight profiles for flight crew and/or flight control support training		✓	STS Operator, Payload Operator - See Note (2) page 1-66
Safety Assessment Report	Establishes that a particular STS vehicle/vehicles and a Payload are, individually and jointly, safe for all flight crew operations required to accomplish the Payload flight objectives.	✓	✓	STS Operator, Payload Operator - See Note (2) page 1-66

Table 1.4-3. Joint Planning Products Common to All Payload Flight Types (Continued)

JOINT PLANNING PRODUCT	FUNCTION	PLANNING JOINT FLIGHT OPERATIONS	PLANNING JOINT TRAIN/SIM EXERCISES	PUBLISHER
Flight Data File Distribution and Logistics Control Plan	Defines controls for updating FDF articles in trainers, simulators, classrooms, and at other facilities		✓	STS Operator
Flight Rules Rationale	Defines reasons, considerations, and tradeoffs used in establishing specific flight rules	✓		STS Operator
Orbiter Consumables Management Plan	Defines utilization of Orbiter system consumables on a flight-specific basis	✓	✓	STS Operator
Simulation Evaluation Reports	Record and evaluation of results of simulator exercises	✓	✓	Joint Simulation Conductor
Training Progress Reports	Status of flight crew/flight controller training and simulation progress		✓	STS Operator, Payload Operator - See Note (2) page 1-66
Network Operations Support Plan	Identifies NASCOM, STS Flight Operator and Payload Operator interfaces	✓		STS Operator

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Table 1.4-3. Joint Planning Products Common to All Payload Flight Types (Continued)

JOINT PLANNING PRODUCT	FUNCTION	PLANNING JOINT FLIGHT OPERATIONS	PLANNING JOINT TRAIN/SIM EXERCISES	PUBLISHER
Flight Rules	Defines flight policies and priorities regarding crew safety and mission objectives	✓	✓	STS Operator
Launch Rule Inputs	Defines requirements/capabilities which must be met to provide a launch commit	✓	✓	STS Operator
Flight Techniques	Defines techniques applicable to flight phases, types, or activities	✓	✓	STS Operator
Product Schedules	Defines schedule/task deliberable tradeoffs within an organization	✓	✓	STS Operator, Payload Operator - See Note (2) page 1-66
Reference Mission Documents	Defines typical flight timelines; used for training and simulations		✓	STS Operator, Payload Operator - See Note (2) page 1-66
Flight Debriefing Plan	Defines emphasis, schedule, and certain specific debriefing questions	✓		STS Operator
Flight Debriefing Report	Final report of flight crew/ flight controller performance, submitted to program management	✓		STS Operator, Payload Operator - See Note (2) page 1-66

Table 1.4-3. Joint Planning Products Common to All Payload Flight Types (Continued)

Footnotes:

(1) A majority of the Flight Data File (FDF) will be published by the STS Operator; however, Payload-related FDF articles may be published by the Payload Operator, or by the STS Operator under special agreement with the Payload Operator. The FDF includes the articles identified below:

STS FDF ARTICLES

- STS Crew Activity Plan
- GN&C Checklist
- Launch/Ascent Checklist
- Rendezvous Checklist
- Deorbit/Entry Checklist
- Rescue Checklist
- Orbiter Software Procedures
- Spacelab Software Procedures
- Orbiter Systems Procedures
- Spacelab Systems Procedures
- Spacelab Activation/Deactivation Handbook
- Earth Observation Handbook
- Orbiter Schematics
- Spacelab Schematics
- Orbiter Malfunction Checklist
- Spacelab Malfunction Checklist
- EVA Checklist
- Photo/TV Operations Checklist
- Orbiter Cue Cards
- Spacelab Cue Cards

PAYLOAD FDF ARTICLES

- Payload Crew Activity Plan
- Payload Experiment Summaries
- Payload Experiment Reference Data
- Payload Cue Cards
- Payload Experiment Procedures
- Experiment Schematics
- Experiment Malfunction Procedures

GENERAL FDF ARTICLES

- Update Books
- Notebooks
- Log Books
- Payload Special Handling Procedures

(2) Segments of these products, pertinent to STS Operations, will be published by the STS Operator; the remaining segments may be published by the Payload Operator, or by the STS Operator under special agreement with the Payload Operator.

training and simulation exercises. The FDF includes all trajectory-related elements, whether joint or individual. These products are applicable to all payload flight-types though the contents may vary among the different payloads.

1.4.5 Joint Planning Products Not Common to All Payload Flight Types

Some products have been identified which are required for joint planning operations, even though they are not common to all types of Payload flights. The products which have been specifically identified are presented in Table 1.4-4, Joint Planning Products Not Common to All Payload Flight Types. Other products, or prospective types of products, are identified and discussed in the sections below.

The basic differences in product requirements for the various payload flights are due to both Payload and STS components used in a flight, as well as the inherent nature of the Payload itself. A matrix of Payload flight types and the STS vehicles required to support these operations is presented in Figure 1.4-1, Payload Flight Types and STS Support Required. This figure shows the various Payload types, the operational mission specified for such payloads, and the types of vehicles required to support such operations.

1.4.5.1 Automated Payload Types Requiring Post-Deployment Propulsion

Within the group of automated payloads there are two basic types: Planetary Payloads and Earth Orbital Payloads. Planetary payloads require an IUS or Tug and possibly a Kick Stage to put the payload on its proper trajectory. Payload packages intended for operations in synchronous or highly elliptical orbits will also require a post-deployment booster. The significant product common to these two types of payloads is identified in Table 1.4-4 as "IUS/Tug/Kick Stage Operations Procedures." This product is significant in that not only is it jointly applied to certain types of flights, but will also be used for planning flight operations wherein the booster will be controlled by different organizations; for example, a booster unit may be controlled by the STS Flight Operator on behalf of a Payload Operator, or directly controlled by the Payload Operator (i.e., DOD flights).

Table 1.4-4. Joint Planning Products Not Common to All Flight Types

JOINT PLANNING PRODUCT	FUNCTION	PLANNING JOINT FLIGHT OPERATIONS			PLANNING JOINT TRAINING/ SIMULATION EXERCISES			PUBLISHER
		SPACELAB	AUTO	IUS	SPACELAB	AUTO	IUS	
IUS/Tug/Kick Stage Operations Procedures	Defines systems moding, sequences, control, management, and operations of a booster system. (1)			✓			✓	STS Operator
Spacelab Payload Support Systems Flight Software Handbook	Reference source for Spacelab operation/support computer software; used for developing procedures and training.				✓			STS Operator
Program Requirements Document	Specifies requirements for Launch and Landing capabilities at ETR and WTR	✓	✓	✓				Range Users (STS Flight Operator and Individual Payload Projects

(1) Joint participation in publication of this product assumes that the IUS, or Tug and/or Kick Stage, are flexible enough to allow participation of the Payload Operator in establishing operating procedures. If the capabilities of these boost devices are fixed (i.e., solid propellant motors with fixed capability), the STS Operator may publish the document without participation of the Payload organizations.

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

<table>
<tr><th>PAYLOAD TYPE</th><th>OPERATIONAL MISSION</th><th>STS VEHICULAR SUPPORT</th></tr>
<tr><td rowspan="3">AUTOMATED</td><td>PLANETARY</td><td rowspan="2">ORBITER WITH IUS/TUG/ KICK STAGE</td></tr>
<tr><td>EARTH ORBITAL
• SYNCHRONOUS
• HIGHLY-ELLIPTICAL</td></tr>
<tr><td>• LOW EARTH ORBIT</td><td>ORBITER ONLY</td></tr>
<tr><td>MANNED</td><td>SPACELAB</td><td>ORBITER AND SPACELAB SUPPORT SYSTEMS</td></tr>
</table>

Figure 1.4-1. Payload Flight Types and STS Support Required

1.4.5.2 Low Earth Orbit Automated Payloads

While no specific products have been identified which are applicable to automated payloads in orbits directly accessible by the Orbiter, several prospective product-related areas are readily identifiable. The unique aspect of Low Earth Orbit payloads is that such payloads may be deployed, retrieved or resupplied or serviced while in such orbits. Certain products are directly applicable to each of these areas. Some flights will require deployment-related products, others will require recovery products; both may be unique to a specific type of payload. Flights intended for on-orbit resupply, service or repair may be unique even for return flights to a particular payload previously visited, depending on the nature of specific flight requirements.

While deployment and retrieval flights require the same level of joint cooperation as other payload flight types, the burden of planning products for resupply or service flights rests with the Payload Operator due to knowledge of the payload to be visited, resupply/service requirements, and payload constraints and operating limitations. These products will be used for planning of joint flight operations and joint training and simulation exercises.

1.4.5.3 Spacelab Flights

One uniquely identifiable product applicable only to Spacelab flights is presented in Table 1.4-4 and deals with the software support functions available for Spacelab operations. Additional products will undoubtedly be required which are unique to Spacelab, based on experiment configuration; many of these will be included in the Flight Data File and are, therefore, types of documents common to other flights. Other Spacelab-related products may be added, deleted or combined as the STS/Spacelab Program matures.

1.5 PREFLIGHT INTERFACES IN PREPARATION FOR FLIGHT OPERATIONS

The focal points for preflight operations in the STS and Payload organizations are the STS Flight Operations Center at JSC, the Lead Payload Development Center, and the Payload Operation Center from which a particular Payload flight will be controlled. It is assumed that the STS Flight Operator will coordinate all activities related to STS vehicles, and the network and launch support required for the flight; it is assumed that a designated Payload Development Center (Lead Center) will normally be responsible for coordination of all activities related to payload flight operations planning. In the following segments, the STS/Payload organizational interfaces will be discussed relative to preflight planning of joint flight operations, and the training and simulation of flight crews and flight control/support personnel required to support flight operations. A basic interface diagram is presented in Figure 1.5-1, Interfaces for Preflight Planning of Joint Flight Operations. Because of the scope and complexity of the STS Program, it will be necessary for individuals or organizations within either the STS organization or the Payload organization to correspond with a counterpart in the other organization; however, because of the sizes and responsibilities of the various Centers, the correspondent organizations and individuals may perform different functions or combinations of functions at different levels within their respective organizations.

Interfaces required for planning, training or simulating multi-payload, multi-discipline, multi-Center payload flights are not discussed in detail herein. It is assumed a "Lead Payload Center" will be assigned for each flight corresponding to the "prime payload" objective onboard. The activities of the other payload organizations would be coordinated by the Lead Payload Center or STS Flight Operator as appropriate.

There are three basic interface levels required for preflight planning of joint flight operations: STS/Payload Program level, Directorate level, and Division level. These levels are based on the existing STS organization structure; Payload organization structures have not been defined, and will probably not be identical. For the purposes of this study, it is assumed that the structures of the three POC's are functionally

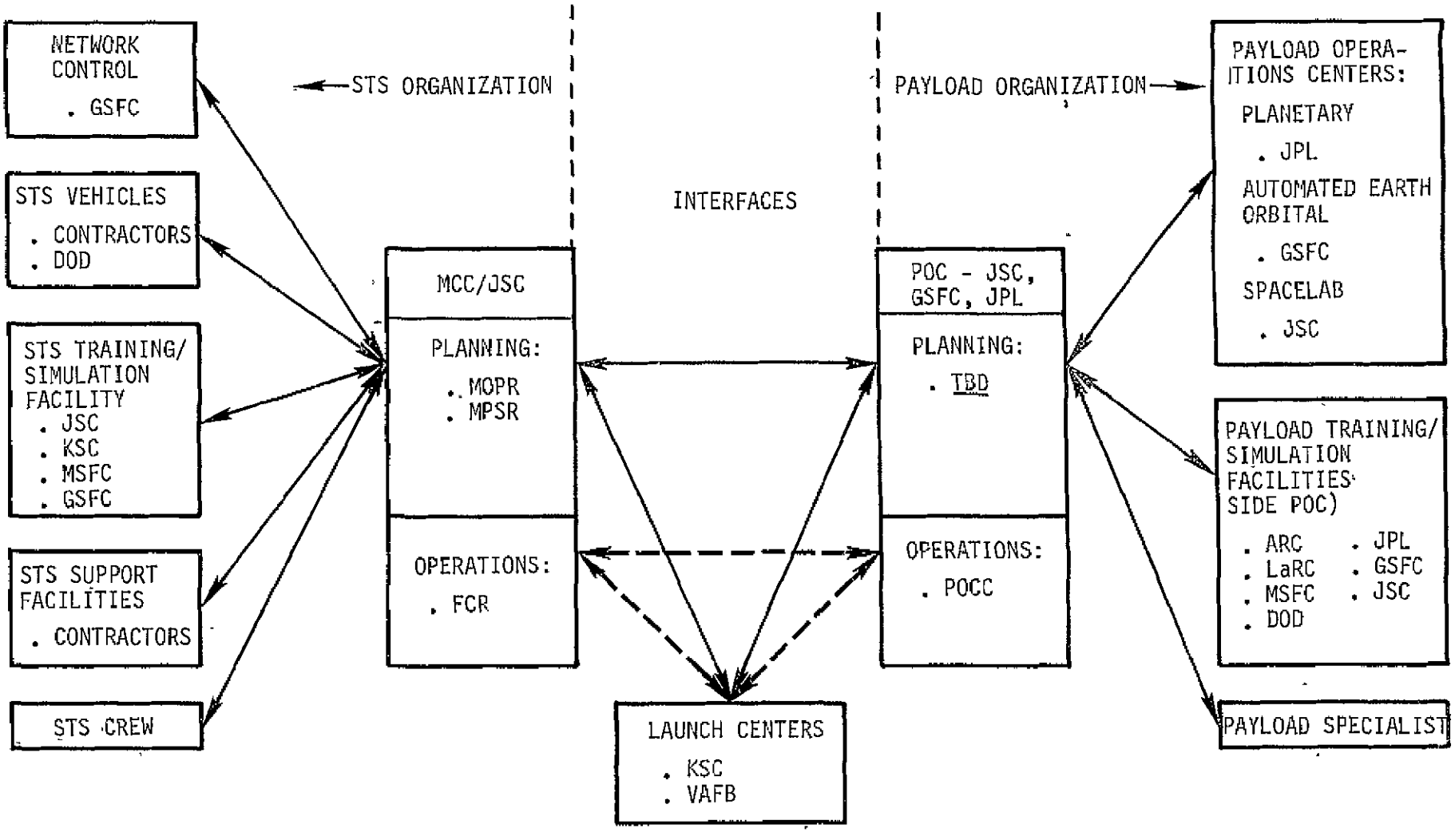

Figure 1.5-1. Interfaces for Preflight Planning of Joint Flight Operations

similar, with due consideration for the nature of specific POC/Payload responsibilities; it is also assumed that since Program-level interfaces have little direct bearing on preflight planning of flight operations, training or simulations, except to specify payload flight requirements, that these interfaces will not be defined in this document.

Additional interfaces may be required when acquisition of facilities or significant items of equipment are involved, especially where implementation and/or execution of joint activities related to joint planning of flight operations or training are involved.

While some interface activities may be conducted on an informal basis, primary emphasis is directed at formal interfaces resulting in joint products.

1.5.1 Preflight Planning Interfaces

Interfaces between the STS and Payload organizations required for preflight planning of flight operations, training and simulation activities will be primarily conducted on two levels: The upper level, which will be called the Directorate level in this document, is responsible for direction and management of all products and functions related to a specific discipline; i.e., trajectory planning, consumables analysis, flight crew activities, etc.; the lower level, herein referred to as the Division level, is responsible for the planning and/or implementation of functions and products within a segment of a discipline.

1.5.1.1 Directorate Level Interfaces

Interfaces must be established for STS/Payload inter-Center operations related to overall direction and management of joint flight crew and flight control/support activities, which include the following areas:

- Provision for and training of flight crews and flight controllers affected by joint operations.
- Recommendations for flight crew member assignments.
- Establishment of training and simulation requirements.
- Development of joint flight crew and flight control/support plans and procedures.

- Establishment of flight control ground instrumentation requirements.
- Contributions to the development of STS/Payload interfaces.

Specific examples of products required for the preflight planning of joint flight operations, which must be negotiated and approved at the Directorate level, are presented in Table 1.5-1, Directorate Level Joint Planning Products. The products presented in this table are either joint products, or products of one Operations Center (STS) which have significant impact on the other major Operating Center (Payload). Products may be added to or deleted from this table as the STS/Payload Program matures.

Equivalent STS and Payload interfaces must be established within corresponding disciplines required to perform preflight planning. For example, NASA/Flight Operations Directorate (FOD) is responsible for flight crews, flight control, and crew training and procedures development; equivalent Payload Organizations must establish interfaces with this Directorate concerning these areas. Simularly, interfaces must be made with the following Directorates at JSC concerned with Payload Operations: Life Sciences; Science and Applications; supportive Directorate functions in Engineering and Development; Data Systems and Analysis; and Safety, Reliability and Quality Assurance. Such interfaces will be established on both a formal basis (particularly where joint or interacting products are required) and on an informal basis (contacts only).

1.5.1.2 Division Level Interfaces

Interfaces are required between STS and Payload Centers in order to implement the activities defined at the Program and Directorate levels. Frequently, these interfaces are also representative of interface requirements during normal real-time flight operations. Products required for preflight planning of joint flight operations are presented in Table 1.5-2, Division Level Joint Planning Products. Activities conducted at the Division level include:

- Design specifications for flight and training data files.
- Distribution and logistics control of joint and individual documents.

Table 1.5-1. Directorate Level Joint Planning Products

Requirements Products:

- Payload Support Systems Onboard Software Requirements
- Onboard Crew Equipment Operations Requirements
- STDN/TDRSS Requirements
- Training System Requirements

Policy Products:

- Baseline Operations Plan
- Data Development and Integration Plan
- Flight Rules
- Payload Support Systems User's Guide
- Crew Procedures Development Plan

Technical Data/Plans/Schedules:

- Joint Product Schedules
- Mission Objectives Document/Payload Mission Plan
- Flight Data File Articles
- Crew Activity Plans
- EVA Description and Design Criteria
- Flight Debriefing Plan and Report

Table 1.5-2. Division Level Joint Planning Products

Requirements Products:

- None

Policy Products:

- Flight Data File Distribution and Logistics Control Plan
- Simulation Evaluation Plans
- Training Data File Definition

Technical Data/Plans/Schedules:

- Flight Operations Integration Handbook
- Communications and Data Operations Plan
- Crew Systems Handbook
- Payload Support Systems Handbook
- Spacelab Payload Support Systems Flight Software Handbook
- Crew Systems Operating Procedures
- Payload Support Systems Operating Procedures
- Orbiter Consumables Management Plan
- Integrated Flight Procedures
- Training Schedules (includes Simulation Schedules)

- Planning constraints, guidelines and techniques, especially when applicable to real-time flight operations planning.
- Classroom, trainer, and simulator hardware, materials, and plans.

As in the previous section, these interfaces are required on both the formal and informal levels. The primary purpose of these interfaces is to produce joint or interactive products within the scope of a Directorate, which are required for completion of a flight-related article or task. For example, planning of the joint flight crew training activities requires an interface between FOD/Astronaut Office, and the Payload organization responsible for Payload Specialist selection and training; similarly, an interface is required between FOD/Crew Training and Procedures Division and the corresponding Payload organization for development of joint flight-related procedures, and establishment of joint training and simulation schedules. Interfaces must also be established between corresponding divisions of the other types of directorates (or equivalents) cited in the previous section.

1.5.1.3 Preliminary Joint Interface Concerns

The areas of joint concern between the STS and Payload organizations related to planning, training and simulations for which interfaces are most immediately required include the following items:

- Guidelines, formats, and techniques for submitting Payload data to the STS organization for generation of joint products and implementation of joint activities.
- Joint product format specifications.
- Establishment of an active role for the Payload Operator in planning of crew operations related to payloads.
- Establishment of POCC capabilities related to joint STS/Payload operations over and above capabilities required for POCC operations exclusively supporting payload operations.
- Establishment of guidelines and ground rules for preparation of joint planning activities, and training and simulation plans.
- Definition of organizations within the designated POC's which correspond to STS functional organizations, and individual POC organizational charts to be used for establishing interfaces at levels equivalent to the STS Program, Directorate and Division levels.

1.5.2 Joint Training and Simulation Interfaces

1.5.2.1 STS or Payload Joint Training and Simulation Exercises

Interfaces required for conducting joint training and/or simulation exercises should be implemented at the Division level. Such interactive exercises require the presence of crew members from both STS and Payload organizations, but are conducted at one Operations Center, and are supported by personnel at that Center.

These joint operations usually involve part-task or full-task exercises on training equipment, such as 1-G trainers, water immersion facilities, or zero-G aircraft training; or part-task or full-task simulation exercises, or simulations capable of providing a joint operations environment.

The primary interfaces between the STS and Payload organizations for training involve the FOD/Astronaut Office, and Crew Training and Procedures Division; and the equivalent offices in the Payload Organization responsible for the Payload Specialist, and the Payload Training organization. Joint data requirements include schedules, training and flight data files, training materials, lesson plans, scripts, evaluation criteria, and training or simulation progress reports. Additional material may be required from either or both organizations.

1.5.2.2 Joint Integrated Simulation Exercises

Joint integrated simulations require support of the STS Flight Operations Center and the responsible Payload Operations Center, as well as the simulation facility required for crew activities. Simulators capable of supporting such exercises include the Shuttle Mission Simulator (SMS) at JSC, with its attendant Network Simulation System (NSS), and the Spacelab Simulator.

In addition to the Division-level interfaces established to support normal training and simulation exercises, some interfaces are required at the Directorate level for scheduling, specific facility or equipment allocations, and inter-Center integration operations required to support joint integrated simulation exercises. NASA/FOD and the Payload equivalent organization are the primary Directorate-level interface agents.

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1.6 FACILITIES INVENTORY

1.6.1 Facility Requirement Identification for Preflight Planning of Flight Operations, Training and Simulations

Planning for all flight operations, training and simulation exercises for a particular flight must be done on a joint basis, including those operations and exercises which are internal to the STS or Payload organizations. Joint planning is required because of schedules which have to be established early in the planning cycles. Because of the types of operations and exercises which must be conducted currently with, and subsequent to, these planning operations, both the STS Operator and the Payload Operator must have access to most of the training/simulation facilities available; because of the projected flight traffic models currently being considered, some planning, training and simulation facilities will have to be duplicated at more than one operating Center. In certain cases, provisions must be made for use of real flight equipment to be used in training and/or simulation exercises.

Several types of facilities have been identified as necessary for joint preflight planning of flight operations and for conducting the training and simulation program required to certify STS and Payload personnel for actual flight operations. These facility types are identified in Table 1.6-1, Facility Type Requirements and Utilization.

Both the STS Flight Operator and the Payload Operator should have the necessary facilities to conduct those planning, training or simulation operations which are truly joint efforts. Individual Centers will be responsible for facilities required for those operations for which each Operator is responsible, even though some joint or cooperative activities are conducted there. Duplicate facilities will be required to conduct simultaneous joint operations due to flight traffic modeling; if at all possible, schedules should be arranged jointly to decrease or remove necessity for duplicate facilities. The facilities listed in the accompanying table may be independent of one another, or may be integrated with other facilities according to the needs or current layout of the various Centers.

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Table 1.6-1. Facility Type Requirements and Utilization (General)

REQUIRED FACILITY	FACILITY UTILIZATION
COMPUTATIONAL FACILITIES	• MATH MODEL SIMULATION AND ANALYSIS FOR PLANNING AND DATA GENERATION • DIRECT SIMULATION/SIMULATOR SUPPORT • DOCUMENTATION PRODUCT GENERATION AND MANAGEMENT - ACCESS TO A COMMON DATA BASE IS HIGHLY DESIRABLE - MAY REQUIRE COMPUTER/COMPUTER OR COMPUTER/DATA BASE INTERFACE BETWEEN CENTERS
TRAINING FACILITIES	• FAMILIARIZATION WITH PAYLOAD FLIGHT-RELATED HARDWARE, VEHICLE OR WORK STATION LAYOUT, AND HABITABILITY OF CREW AREAS • FAMILIARIZATION WITH SOME ORBITER/PAYLOAD OPERATIONAL CAPABILITIES AND CONSTRAINTS • FEASIBILITY STUDIES OF POTENTIAL PROCEDURES APPLICABLE TO A FLIGHT OPERATION • CLASSROOM FACILITIES, AS REQUIRED - AUDIO/VISUAL EQUIPMENT - GDP TERMINALS
SIMULATION FACILITIES	• REAL-TIME PERFORMANCE OF FLIGHT-SPECIFIC TASKS BY JOINT FLIGHT CREWS IN A HIGH-FIDELITY ENVIRONMENT • CERTIFICATION OF STS AND PAYLOAD PERSONNEL AND/OR PROCEDURES • REAL FLIGHT-TYPE PAYLOAD HARDWARE MAY BE USED TO PROVIDE REALISTIC SIMULATIONS - INTERFACE AND SUPPORT EQUIPMENT REQUIRED

Table 1.6-1. Facility Type Requirements and Utilization (General) (Continued)

REQUIRED FACILITY	FACILITY UTILIZATION
FLIGHT CONTROL/ SUPPORT FACILITIES	• INTERFACED WITH SUITABLE SIMULATION EQUIPMENT TO PROVIDE INTEGRATED SIMULATION CAPABILITY, COMMENSURATE WITH ACTUAL OPERATING REQUIREMENTS • CERTIFY INTEGRATED GROUND OPERATIONS, PROCEDURES AND PERSONNEL REQUIRED TO SUPPORT JOINT ONBOARD OPERATIONS
PUBLICATION FACILITIES	• PUBLISH JOINT OR INTERNAL PRODUCTS PERTINENT TO CONTROL OR SUPPORT OF A FLIGHT • PUBLISH AND FLIGHT-QUALIFY DOCUMENTS REQUIRED FOR ONBOARD OPERATIONS • SUPPORT REGULAR OPERATIONAL REPRODUCTION REQUIREMENTS FOR JOINT OPERATIONS
GENERAL OFFICE/ MEETING SUPPORT FACILITIES	• REQUIRED FOR NORMAL CENTER OPERATIONS, INCLUDING PLANNING, CONTROL OR SUPPORT OF JOINT AND/OR INTERNAL OPERATIONS • REQUIRED FOR JOINT MEETINGS

1.6.1.1 Planning Facility Requirements

Of those types of facilities presented in Table 1.6-1, the primary facilities required to support preflight planning of joint flight operations include the computational facilities, publication facilities, and the general office/meeting/support facilities. The remaining facilities are useful to some degree where specific problems must be worked out, but in general, planning operations are oriented more towards personnel-related operations than hardware- or facility-related operations, except where scheduling is involved.

1.6.1.2 Training and Simulation Facility Requirements

The primary facilities required for conducting training and simulation exercises include computational facilities, training and simulation facilities, and flight control/support facilities. The remaining facilities may be used to support such exercises, but training and simulation operations are generally oriented to facilities capable of handling STS or Payload-type hardware, and the computers required to support simulation exercises. The ground-based control/support facilities used for actual flight control/support will interface with some simulations and their computational facilities to provide integrated simulations, and to perform end-to-end preflight systems checkout if the real Payload can be interfaced to the simulation systems.

1.6.2 Center Functions and Status

Each Center listed in Table 1.6-2, Facility Status of STS/Payload Operating Centers, is responsible for one or more functions related to planning of STS or Payload flight operations, and the training required to certify flight or ground personnel to carry out those functions for a specific flight.

- JSC is responsible for STS Flight Operations and Spacelab Payload Operations; this includes all flight crew training related to STS vehicles. Flight crew training and simulations for Spacelab will be conducted primarily at JSC but could also be performed at MSFC where capability exists.

- MSFC plans capabilities such as integrating Spacelab experiment configurations, data management, STS/Spacelab interfacing; and some portions of Neutral Buoyancy training, particularly as applied to Spacelab EVA operations.

Table 1.6-2. Facility Status of STS/Payload Operating Centers

STS OR PAYLOAD OPERATING CENTER	CENTER TYPE	CENTER FUNCTION	FACILITY TYPE					
			COMPUTATIONAL	TRAINING	SIMULATION	FLT CONT/ SUPPORT	DUPLICATION	OFC/MTG/ SUPPORT
JOHNSON SPACE CENTER (JSC)	MCC/POC	STS FLT OPR/ PAYLOAD OPS	E	E	E	M	E	E
MARSHALL SPACE FLIGHT CENTER (MSFC)	SUPPORT FACILITY	PAYLOAD SUPPORT	E	E	E	E*	E*	E
GODDARD SPACE FLIGHT CENTER (GSFC)	POC/NOCC	PAYLOAD OPS/ NETWORK OPR	E	P	P	E	E*	E
JET PROPULSION LABORATORY (JPL	POC	PAYLOAD OPS	E	P	P	E	E*	E
LANGLEY RESEARCH CENTER (LaRC)	SUPPORT FACILITY	PAYLOAD SUPPORT	E	P	P	NR	E*	E
AMES RESEARCH CENTER (ARC)	SUPPORT FACILITY	PAYLOAD SUPPORT	E	P	P	NR	E*	E
KENNEDY SPACE CENTER (KSC)	LAUNCH/ LANDING	LAUNCH/LANDING CENTER	E	E	E	E	E*	E
VANDENBERG AIR FORCE BASE (VAFB)	LAUNCH/ LANDING	LAUNCH/LANDING CENTER	E*	R	NR	NR	E*	E*
AIR FORCE SATELLITE CONTROL FACILITY (ASFCF) (AND RELATED DOD FACILITIES)	POC	DOD FLT OPS	E*	P*	P*	E*	E*	E*

LEGEND:
- E FACILITIES EXIST, EQUIPMENT EXISTS OR IS BEING PROCURED
- P EQUIPMENT AND/OR FACILITIES PLANNED
- R EQUIPMENT AND/OR FACILITIES REQUIRED
- M EQUIPMENT/FACILITY CURRENTLY EXISTS; CURRENTLY BEING MODIFIED TO MEET STS PROGRAM REQUIREMENTS
- NR NOT REQUIRED (DOES NOT PRECLUDE ACQUISITION OR ACTIVATION OF SUCH EQUIPMENT OR FACILITIES)
- * EXISTS OR IS PLANNED AT THIS CENTER, OR CONTRACTOR FACILITIES IN AREA, TO THE DEGREE COMMENSURATE WITH PLANNING, TRAINING AND SIMULATION REQUIREMENTS OF THE OPERATOR OR CENTER INVOLVED.

- GSFC has been given responsibility as Payload Operating Center (POC) for Automated Earth-Orbiting Payloads, including low orbits, elliptical orbits, and synchronous orbits. GSFC also controls network requirements for STDN via the Network Operations Control Center (NOCC).

- JPL is responsible for Planetary Payload Operations based on previous experiences, including Deep Space Network (DSN) operations.

- LaRC is responsible for some specific Payload-related planning, training and simulations, supporting POC operations on payloads sponsored by LaRC (i.e., LDEF, ATL, etc.).

- ARC is responsible for certain Payloads/Experiments, such as in Bioscience or Life Sciences discipline.

- KSC is responsible for planning of certain STS/Payload integration activities, and the training of flight crew on launch operations, including appropriate simulations.

- VAFB may provide some planning functions applicable to that Center in particular, as related to launch operations on the Western Test Range (WTR). Training and simulations at VAFB will be limited with respect to the STS Program.

- AFSCF (or some other DOD facility or organization) will be responsible for coordinating and implementing the planning of DOD flight operations, and the training and simulation activities required to support such operations. Activities or equipment may involve security provisions.

1.6.3 Control Center Facilities

There are four primary POC facilities participating in STS Program operations: JSC for Spacelab Payloads; GSFC for Automated Earth-Orbiting Payloads; JPL for Planetary Payloads; and a DOD POC-equivalent facility to be prospectively located at the Satellite Test Center (STC), which is part of the AFSCF organization located at Sunnyvale, California. Many of the payloads which have been assigned to these Payload Operations Centers have been mentioned previously in Tables 1.2-1 through 1.2-4 in Section 1.2, Applicable Flight Types/Payloads and Operational Interfaces. The types of facilities required to support preflight planning of flight operations, training and simulation have been identified in Table 1.6-1. Discussions of the present POC capabilities are presented below.

1.6.3.1 JSC Spacelab POC

While JSC is responsible for operational flight control of the Spacelab support systems and certain payload flights, JSC is only partially responsible for the planning, training and simulation activities associated with other Spacelab payload flights. MSFC, GSFC and LaRC also retain some responsibility for certain Spacelab payload flight types, as identified in Table 1.2-1. JSC either currently possesses or is modifying existing facilities required for preflight planning of flight operations, training and simulations required for Spacelab operations. JSC is responsible for the overall scheduling required to integrate all Spacelab operations.

The NASA complement of training and simulation equipment is mainly divided up between JSC and MSFC. Applicable equipment at JSC includes the Spacelab Simulator which is a high-fidelity, computer-interactive training and simulation device; a high-fidelity (Hi-Fi) Spacelab mockup (1-G trainer); the Shuttle Mission Simulator (SMS) and an Orbiter 1-G Trainer for payload-related Orbiter training. JSC facilities also include Water Immersion Facilities (WIF) or Neutral Buoyancy (NB) facilities for EVA training, and several other training and simulation devices which may be used for Spacelab training. Existing flight control facilities are being modified for Orbiter/Spacelab FCR/POCC operations.

Spacelab-related training and simulation equipment at MSFC includes the General Purpose Lab (GPL), which is a flexible Spacelab mockup; the Data Management System Simulator (DMSS) used in simulating Spacelab data management; a Neutral Buoyancy facility suitable for Spacelab EVA development; and additional Payload simulations and support equipment for all Spacelab-related training and simulation equipment. MSFC has sufficient planning facilities and capability to utilize this equipment in conjunction with the other Spacelab participants.

GSFC is currently acquiring a Shuttle Bay Simulator (SBS), which can be used in Spacelab experiment integration and experiment-related crew training.

LaRC does not have planning or operational support facilities for Spacelab, but some provisions for such facilities are being made.

All Spacelab-related facilities have, or are acquiring, the computational capability to support preflight planning, training and simulations for the duration of the STS Program.

1.6.3.2 GSFC Automated Earth-Orbit POC

GSFC is the POC responsible for planning and implementation of Automated Earth-Orbital Payloads. GSFC currently has the planning facilities to support their complement of payload-related equipment and facilities. Training and simulation equipment includes the following items: POCC facilities, for training and real-time flight operations; the SBS, for testing and evaluation of payloads in an Orbiter payload bay environment; ATS Simulator (ATSSIM), for all training and simulation required for support and control of ATS-type spacecraft; International Ultraviolet Explorer Simulator (IUESIM), used for training NASA/ESRO personnel for support and control of the IUE Spacecraft; and other complementary or support facilities required for planning or implementing support activities for Automated Earth-Orbital Payloads.

1.6.3.3 JPL Planetary POC

JPL currently has the planning, training and simulation capabilities required to support multiple planetary payload missions simultaneously; facilities and equipment required to support current operations are adequate to support STS payload operations. The only major impact on JPL is the utilization of STS vehicles for payload delivery instead of an expendable booster.

1.6.3.4 Department of Defense (DOD) Payload Facilities

The Department of Defense intends to establish STS payload control facilities in conjunction with its existing Satellite Test Center (STC), which is part of AFSCF, Sunnyvale, California. DOD also intends to develop a facility called the Shuttle Operations Planning Center, (SOPC), to provide the capability to conduct the classified portions of planning required for DOD operations. For the most part, DOD plans to utilize NASA facilities wherever and whenever possible for all preflight planning, training and simulation exercises. DOD currently possesses the capability to plan payload flight operations, parts of the training and simulation requirements, and the computational capability to support the flight operations.

1.6.3.5 Network Operations Control Center (NOCC)

In addition to the AEO payload tasks allocated to GSFC, that Center is also responsible for acquisition and implementation of a facility to control, schedule, and integrate communications and data management via the STDN/TDRSS network. GSFC currently has the capability to plan such operations, and has a Network Test and Training Facility (NTTF) to assist in planning and training activities related to network operations.

1.6.4 Payload Development and Support Facilities

Several other facilities are participating with the STS Program as Payload Development and Support Centers. These Centers are not responsible for payload flight control, but are responsible to the POC's for experiment and/or payload development, and portions of preflight planning, training and simulations relevant to these payloads or experiments. These Centers will also furnish Payload Operations personnel to operate from the POCC's at JSC or GSFC as applicable. The Centers which have been identified as development and support facilities are discussed below.

1.6.4.1 Marshall Space Flight Center (MSFC)

In addition to the potential MSFC role in Spacelab, discussed in Section 1.6.3.1, MSFC has capabilities to develop and support operations related to other payloads. These capabilities include the Mission Development Simulator (MDS), for earth observation training; the Shuttle Interface Simulator (SIS), which functionally represents the Mission Specialist (MS) interface between the Orbiter and the Payload; several payload simulators, which can be used separately or integrated to represent a payload; Data System Simulator (DSS), to model the experiment/payload data stream; and other Systems Support Equipment (SSE) and Mechanical Support Equipment (MSE) necessary to complement all payload and Spacelab simulation equipment. Prospective acquisition of additional capabilities will be discussed in Section 1.7.

1.6.4.2 Ames Research Center (ARC)

ARC has capabilities required for planning long-duration missions for Automated Earth-Orbital Payloads, and to support Automated Earth-Orbital or Planetary Payloads. ARC has planning facilities, and facilities for

training ground support personnel for appropriate payload flights. Currently, facilities and capability to familiarize flight crew personnel with payload or experiment operations via trainers and simulators do not exist; requirements for this capability will be discussed later.

1.6.4.3 Langley Research Center (LaRC)

LaRC currently possesses limited training and simulation capabilities, although preflight planning capabilities for flight operations, training and simulations do exist. These capabilities may require expansion for STS operations. No flight control facilities are required, and limited facilities are available to host real-time scientific investigations during a flight.

1.6.5 International Facilities

The European Space Agency (ESA) is currently scheduled to participate in the first Spacelab flight, with possible plans for an additional flight. ESA currently has no experience or capability for planning manned orbital flight activities, or to conduct the training or simulations required to support ESA experiment operations. ESA participation in preflight planning of flight operations, training and simulations will be discussed in Section 1.7.8.

1.6.6 STS Flight Operator Facilities

The STS Flight Operator (NASA/JSC) has extensive capabilities related to planning and implementation of flight operations, training and simulations. These capabilities include preflight planning of flight operations, training and simulations for all phases of flight for all STS vehicles, and for planning and certain training activities related to Spacelab operations (1.6.3.1). Some idea of the complex capability of the STS Flight Operator's training and simulation equipment is provided in Table 1.6-2, STS Flight Operator Training and Simulation Capabilities. These articles of equipment are in addition to those identified in Section 1.6.3.1. Table 1.6-3 identifies equipment, outlines its capabilities, and indicates equipment utilization and limitations for payload-related training operations only; training and simulation capabilities for STS flight operations are much more extensive. Extensive modifications and major acquisitions have been undertaken to meet STS and Payload operational requirements at JSC.

Table 1.6-3. STS Flight Operator Training and Simulation Capabilities

SIMULATOR	CAPABILITY	UTILIZATION FOR PAYLOAD-RELATED TRAINING	LIMITATIONS WITH RESPECT TO PAYLOAD TRAINING
CPES (Crew Procedures Evaluation Simulator)	• Auto/Manual Control Modes • Variable Flight Control and Aerodynamic Parameters • Limited Fidelity Crew Station • Limited Systems Models • Rapid Turnaround and Reinitialization	None	1) Front cockpit only 2) Limited system models 3) Undefined after CY77
SPS (Shuttle Procedures Simulator)	• Real-Time 6 DOF Simulation of All Flight Phases • Functional Models of Motor Systems • Functional Models of GN&C and Displays (using some flight hardware/software) • Planned Incorporation of Z-Axis Docking Station • Visual System for Out-the-Window Views, Including Docking	Flight Crew: Basic medium fidelity docking	1) Front cockpit with Z-axis docking station
OAS (Orbiter Aeroflight Simulator)	• High-Fidelity CDR/PLT Crew Stations • Flight Computational Hardware/Software • 6 DOF Motion Base	None	1) Front cockpit only 2) Incorporated into SMS MBCS (3-78)

Table 1.6-3. STS Flight Operator Training and Simulation Capabilities (Continued)

SIMULATOR	CAPABILITY	UTILIZATION FOR PAYLOAD-RELATED TRAINING	LIMITATIONS WITH RESPECT TO PAYLOAD TRAINING
SMS (Shuttle Mission Simulator)	• High-Fidelity Crew Stations (FBCS includes MS/PS stations) • High-Fidelity Models of All Systems • Flight Hardware and Software • Provides Training for All Phases of Flight • Integrated with MCC for Flight Crew and Support Personnel Integrated Training • High-Fidelity Visual System • High-Fidelity Interfaces between Crew and Hardware/Software	FBCS particularly applicable to all phases of Orbiter-related payload operations, including checkout, C&W/safing, deployment, retrieval, and Orbiter tasks related to these operations	N/A
SLS (Spacelab Simulator)	• Provides Integrated Orbiter-Spacelab Training • Contains Realistic Orbiter-Spacelab Interfaces • Provides Spacelab System Models • SMS and SLS provide Capability to provide Integrated Orbital Training for Spacelab Flights	Provides Hi-Fi facility for conducting flight-specific payload-related training to all flight crew members, as well as interrelated Orbiter-Spacelab activities	N/A

Table 1.6-3. STS Flight Operator Training and Simulation Capabilities (Continued)

SIMULATOR	CAPABILITY	UTILIZATION FOR PAYLOAD-RELATED TRAINING	LIMITATIONS WITH RESPECT TO PAYLOAD TRAINING
ALSA (Airlock Simulator Assembly)	TBD	EVA training for regular or contingency Payload/Orbiter operations	N/A
MMU/EMU (Manned Maneuvering Unit/ Extravehicular Maneuvering Unit)	• High-Fidelity Self-Contained Propulsion/ Guidance Unit to Provide Transportation to/from an EVA Work Station • High-Fidelity Crew Interfaces	Translation to/from prospective payload work station; maneuverability at work stations	1) Motion one axis at a time
Payload Simulators	TBD	Provide MS/PS interface with typical/realistic payload for all Orbiter-related operations Provide POCC interface with typical/realistic payload for independent operations training	Undefined
SST (Single System Trainers)	• Trainers for Individual Orbiter Systems	MS/PS monitor payload systems via Orbiter systems operations (e.g., EPS, consumables, etc.)	Undefined
RMS (Remote Manipulator Simulator)	TBD	Payload deployment/ retrieval manipulation	Undefined

Table 1.6-3. STS Flight Operator Training and Simulation Capabilities (Continued)

SIMULATOR	CAPABILITY	UTILIZATION FOR PAYLOAD-RELATED TRAINING	LIMITATIONS WITH RESPECT TO PAYLOAD TRAINING
IUSS (Interim Upper Stage Simulator	TBD	Provides crew/ground/IUS interface simulation applicable to all flights requiring position or velocity beyond Orbiter capability, such as planetary or synchronous orbit payloads	Undefined
NSS (Network Simulation System)	• Air/Ground, Ground/Ground Interface Simulation • SMS/MCC Interface • Malfunction Insertion/Monitoring • Audio/Video/Data Interface Control • Simulates Orbiter Data/Timing Interface • Distributes Visual Simulations to Simulators	Payload data and communication support Payload visual inspection Payload troubleshooting using C&W analysis of malfunctions	N/A
GDP (Generalized Documentation Processor)	• Automated Document Editing/Management • CRT Display or Hardcopy Printout Capability • Remote Display Capability • Rapid Access to STS Data Base	Payload document management	N/A

Table 1.6-3. STS Flight Operator Training and Simulation Capabilities (Continued)

SIMULATOR	CAPABILITY	UTILIZATION FOR PAYLOAD-RELATED TRAINING	LIMITATIONS WITH RESPECT TO PAYLOAD TRAINING
T-38	• Medium Fidelity Approach and Landing Training • Flight Proficiency	None	N/A
STA (Shuttle Training Aircraft)	• High-Fidelity Approach and Landing Training	None	1) Primary flight crew only
KC135	• Zero-G Familiarization • Heavy Aircraft Familiarization	None	N/A
1-G Trainers • Orbiter • IUS (TBD), • Tug (TBD)	• Orbiter Familiarization • Crew/Hardware Interface Verification • Develop Flight Procedures and Equipment Handling Techniques	Payload-related hardware operations within the capability of the Orbiter can be verified in the 1-G trainers, as well as form/fit tests of hardware carried/used in the Orbiter	N/A
Neutral Buoyancy Trainers	• Verification of Hardware Design, Form and Fit • Exercise Procedures in Simulated Zero-G Environment • Provide Shape and Volumetric Mockups during Procedure Development, Evaluation, and Crew Training	Provide near-zero-G environment for familiarization training related to Orbiter and Payload hardware handling operations	N/A

1.6.7 Launch/Landing Facilities

Two launch/landing facilities are planned for use during the STS Program operational phase: Kennedy Space Center (KSC) and Vandenberg Air Force Base (VAFB). Landing facilities will also be available at Edwards AFB, plus several contingency landing sites at other locations.

1.6.7.1 Kennedy Space Center (KSC)

KSC facilities to support STS operations are currently being constructed or modified to meet operational requirements. Due to responsibilities in previous and current NASA programs, KSC has sufficient facilities available for the necessary preflight planning of flight operations, training and simulations required to support these operations. Primary simulation device at KSC is the Shuttle Ground Operations Simulator (SGOS) used to train and simulate crew activities during the prelaunch phase. Host facilities for experimenters also exist.

1.6.7.2 Vandenberg Air Force Base (VAFB)

There are no training or simulation facilities currently available at VAFB capable of supporting STS launch/landing operations. VAFB does have the facilities and capability to plan ground support operations for STS flight operations.

1.7 ADDITIONAL PAYLOAD FACILITIES FOR THE OPERATIONAL PHASE

The previous section contains a discussion of facilities and equipment which will be utilized on the STS and associated Payload Projects for preflight planning of flight operations, training and simulation. These facilities or articles of equipment will be used in either their existing form or modified to conform more closely with STS and Payload requirements.

This section will discuss new facilities or equipment required to satisfy STS and Payload requirements which will not be met through utilization of existing capabilities.

1.7.1 Spacelab Payload Facilities/Equipment

All of the major facilities and articles of equipment necessary for preflight planning of flight operations, training and simulations for Spacelab operations, for flight crews and flight operations support personnel, either exist or are planned for acquisition by JSC or MSFC. All planning tools required to support Spacelab flights will be available between 4 months prior to launch and 2 years prior to launch, as required for a particular Spacelab flight. Training and simulation equipment necessary to complement the preflight planning will be available at JSC or MSFC.

JSC and GSFC have established programs to assure POCC personnel are trained to support the planned Spacelab operations. JSC, GSFC, and MSFC have facilities capable of supporting the planning of scientific investigations applicable to payloads or experiments allocated to those Centers; LaRC and ARC do not have such facilities. LaRC and ARC need to provide scientific planning and evaluation facilities for the payloads or experiments allocated to them, or to arrange suitable facilities at the responsible POC (JSC) or an equivalent facility.

1.7.2 Automated Earth-Orbital Payload Facilities/Equipment

No major additional facilities will be required to support planning for Automated Earth-Orbital Payloads. The only difference between current operations and STS operations is the method of payload delivery to final orbit using STS vehicles instead of expendable boosters. Since delivery operations are controlled by the STS Flight Operator, there are no requirements for GSFC equipment or operations supporting boost operations.

GSFC and JSC will be responsible for providing training and simulation equipment required to familiarize flight crew personnel with STS/Payload interface operations; these projects have already been undertaken at both Centers.

1.7.3 Planetary Payload Facilities/Equipment

No major additional facilities will be required to support planning for Planetary Payloads. The only difference between current operations and operations during the STS Era is the method of payload delivery to final orbit using STS vehicles instead of expendable boosters. Since delivery operations are controlled by the STS Flight Operator, there are no requirements for JPL or GSFC equipment or operations supporting boost operations.

1.7.4 Network/Communications Facilities

A Network Operations Control Center needs to be established to coordinate and integrate network communications between all STS Network participants during the operational phase. Since GSFC has been responsible for the Network Test and Training Facility since 1966, location of the NOCC at GSFC (for both STDN and DSN) would assure continuity of network operations, and also assure a group of experienced network-qualified personnel for early operational support. GSFC would continue its role as prime tracking and data acquisition facility for ERTS (LANDSAT) for the International Ultraviolet Explorer (IUE) Program, and other Payload Programs.

1.7.5 STS Vehicle Flight Operations Facilities

Orbiter flight operations will be controlled from JSC; facilities and equipment required for planning and implementation of Orbiter operations already exist or are being acquired or modified to meet STS operational requirements.

If DOD plans to become an independent STS Flight Operator, DOD must acquire, at a minimum, the equipment and facilities required to provide ground support complementary to the Orbiter autonomous operating capabilities. If the Orbiter alone cannot provide DOD with the capability to

meet DOD payload orbital characteristics, DOD must also acquire the data processing capability to allow an Orbiter to meet DOD payload operating requirements. The DOD flight control complex required to support independent Orbiter operations does not have to duplicate the NASA/JSC facility, but does have to provide similar support functions. DOD will also have to supplement NASA training and simulation equipment or facilities if classified material or operations impact unclassified NASA facilities. This supplementation may be in the form of functionally duplicate facilities and equipment, or may result in securing (temporarily or permanently) some facilities or equipment.

For Interim Upper Stage (IUS) operations, flight control facilities will be required at JSC (for regular IUS operations), at DOD facilities (for a security buffer between unclassified Orbiter operations and classified payload trajectory/position), and possibly at JPL for planetary flights.

Flight control facilities for the Space Tug will also be required at JSC, and possibly at the DOD facility and JPL. Final requirements are TBD.

1.7.6 Redundant Capabilities

In the event of a support capability failure at a primary POC, another POC should have redundant capabilities to provide flight operations support; this should be factored into preflight planning of flight operations, and certain POC personnel at the alternate POC should be familiarized with upcoming flights for which they may provide contingency support. Suggestions for redundant POC responsibilities are presented in Table 1.7-1, POC Responsibilities for Alternate Flight Operations Support. Facility or equipment acquisitions required to implement these redundant capabilities are TBD.

1.7.7 Launch Facilities

If launch facilities at VAFB are different from those at KSC, some provisions must be made for training flight crew personnel to implement Emergency Egress procedures while the Orbiter is on the launch pad at VAFB. This training may be accomplished on the SGOS at KSC, suitably modified to represent the VAFB installation, or on a new trainer at VAFB. If the SGOS is altered, it must be configurable for both KSC and VAFB configurations.

Table 1.7-1. POC Responsibility for Alternate Flight Operations Support

OPERATIONS TYPE	CENTER		RATIONALE FOR ALTERNATE
	PRIMARY	ALTERNATE	
STS Flight Operations	JSC	None	No alternate capability
Spacelab Operations	JSC	GSFC	Previous experience in orbital operations support
Automated Earth-Orbital Payload Operations	GSFC	JSC	Previous experience in orbital operations support
Planetary Payload Operations	JPL	GSFC	Previous experience in unmanned operations support
DOD Payloads	DOD	None	Security
DOD STS Flight Operations	DOD	JSC	JSC is prime for DOD STS FO, initially; therefore, has capability to become Alternate, later.

Familiarization with experiment flight hardware operations is also obtainable at the launch facilities during prelaunch test and checkout activities (this is only opportunity to "train" on actual experiment flight hardware in most cases).

1.7.8 International Facilities

For those payload experiments sponsored by the European Space Agency (ESA), the ESA should normally be expected to provide planning support and training in a manner similar to that provided by NASA Centers or other organizations in the USA. If ESA involvement were limited to only one or two flights, it would be feasible for ESA not to build up a capability themselves but to contract the work to one of the NASA Centers. However, for a long term involvement, it would be important for ESA to perform Payload preflight planning support for flight operators, training on both flight equipment and associated POCC functions, and appropriate simulations.

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1.8 ASSUMPTIONS, CRITERIA AND RATIONALE FOR FUNCTION AND PRODUCT ALLOCATIONS TO STS, PAYLOAD AND NETWORK FACILITIES

1.8.1 Assumptions

The following assumptions are applicable with relation to this study of preflight planning of flight operations, training and simulation exercises. These assumptions will be applied in the allocation of tasks, functions, and/or products to the STS, Payload or Network Centers.

- This study addresses STS Payloads and payload flights scheduled during the operational phase of the STS Program (post-OFT).
- This study is based on selected payloads and flight types as submitted by the COR and specified in the Study Plan, Reference 13.
- The STS Flight Operator is exclusively responsible for generation of STS related products and functions, including the definition of Payload support and interface.
- The Payload Operator is exclusively responsible for generation of Payload organizational and equipment-related products and functions, including the definition of Payload operations and interface requirements with the STS flight articles and with ground facilities.
- The Network Operator is exclusively responsible for establishing, maintaining and managing of communications and data transmission during all major STS/Payload integrated operations, including training exercises and real-time operations.
- Each POC is dedicated to operation and support of one particular type of payload flight (JSC-Spacelab, GSFC-Automated Earth Orbital, and JPL-Planetary).
- Backup operations and support capability may be established at an alternate POC or other support facility whose primary responsibility in the Program most nearly matches the requirements of the original POC (e.g., GSFC backup to JSC Spacelab operations, JSC backup to GSFC Automated Earth Orbiting operations).
- Product and function allocation will be done in such a manner as to maximize use of existing facilities and capabilities. Where additional equipment is justifiably required at a particular POC, such equipment must be compatible with similar equipment at other POC's, to assure maximum hardware and software utilization, uniform interface requirements, and lower per-unit acquisition costs.
- DOD will be considered a Payload Operator/STS User for the purpose of this study; if DOD becomes an STS Flight Operator, then those DOD operations will fall outside the scope of this study.

- Detailed "Flight Planning" for Payloads is the responsibility of the Payload Developer, the Payload Operations Center (POC) and/or associated Payload Operations Control Center (POCC). Detailed "Flight Planning" for the STS and integration of "Flight Plan" content for STS and STS Payloads is the responsibility of the STS Flight Operator (MCC/JSC).

1.8.2 Criteria and Rationale for Product/Function Allocation

1.8.2.1 Payload-Related Product or Function Allocations Unique to a Payload Operator

Payload-related products and/or functions which are unique to a specific payload will be allocated to the appropriate Payload Operator; those that are applicable to a particular payload flight type should be allocated to the POC specifically responsible for that payload flight type, where possible, to take advantage of experience factors. Further breakdown of product function assignments will be done by, and at the discretion of, the Payload Operator in conjunction with appropriate POC. Tasks particularly related to specific experiments may be further allocated by the Payload Operator to the experiment developer.

Planning for flight familiarization, training, and interfacing required for backup operations at an alternate POC should be done by personnel at the POC which has primary responsibility for the particular payload involved.

Payload-unique products and functions which do not impact STS vehicle preflight planning, training or simulation requirements will be allocated exclusively to the Payload organization or to the POC specifically responsible for a particular payload flight type.

1.8.2.2 Payload-Related Products or Functions Requiring Cognizance of, or Contributions by, the STS Flight Operator or Network Operator

Certain products or functions which require cognizance of, or contributions by, the STS Flight or Network Operator will be allocated to the appropriate Payload Operator/POC. Such tasks include STS vehicle-related data required to effectively plan orbital scientific operations, schedule flight crew availability for participation in payload-related training and/or simulation exercises, and the communications network requirements necessary to support such operations.

The Payload organization will also be allocated some functions or products for which the STS Flight Operator must be cognizant from a safety or support standpoint, such as consumables utilization, impact on an STS vehicle of payload system operations in nominal and off-nominal modes, or crew support requirements.

Payload-related products or functions which require cognizance or contribution from other organizations, but for which the Payload organization retains operational responsibility during flight, will be allocated to the POC specifically responsible for that particular payload flight type.

1.8.2.3 Allocation of Joint Products and Functions

Joint products or functions requiring active participation of both the STS Flight Operator and the Payload Operator will be allocated to the organization which either (1) has greatest dependence and responsibility for the product or function, or (2) has the capability to produce such an item or action based on existing capability or previous experience. The organizational level to which they will be assigned is the responsibility of the selected Operator. In the event that some products or functions may be required which are not uniquely allocatable to any STS organizations, a joint panel of representatives of all interested parties needs to be established to allocate responsibility for those products or functions; the allocation criteria for such a panel to use would be established by the panel itself.

Scheduling of activities and joint meetings required to implement these products or functions will be established by the responsible organization, based on agreement among the panel members.

1.8.2.4 Network or STS Vehicle-Related Products or Functions Requiring Cognizance of, or Contributions by, the Payload Operator

Network or STS vehicle-related products or functions which require cognizance of, or contribution by, the Payload Operator, will be allocated to the organization most suited by capability and experience for such products or functions. Within the Payload organization, however, the Payload Operator will be responsible for allocating (or generating)

contributions to other STS-related products or functions, or for establishing responsibility for cognizance of non-Payload products within the Payload organization.

The Payload organization is responsible to the STS Operators for establishing Payload contributions to joint products or functions, and is itself responsible for cognizance of the products and functions of other Payload Operators.

1.8.2.5 Products or Functions Unique to Non-Payload-Related Operators

The Payload organization is responsible only for acquiring those products, or participating in those functions, which may be useful in preflight planning of flight operations, training or simulation exercises involving the Payload. All Operators should be notified of the products or functions of other Operators as a matter of record to assure optimum utilization of the data by STS and Payload Operators. Interdisciplinary data exchanges should be possible even if they are not specifically required.

1.9 ALLOCATION OF JOINT PRODUCTS AND FUNCTIONS TO PAYLOAD-RELATED FACILITIES

This section is devoted to the allocation of products and functions, identified in Sections 1.3 and 1.4, to the STS/Payload participants identified in Section 1.6. These products and functions will be generated or implemented at facilities identified in Sections 1.6 and 1.7.

There are two parts to this section: the allocation of products and functions which are common to all Payload Operations; and the allocation of products and functions applicable to certain Payload Operators or support facilities. The allocation of products or functions by one Payload Operator to another payload facility is internal to the Payload organization and is not discussed in this document.

There are three types of products or function: (1) joint functions, which require integrated, simultaneous operations by the STS Flight Operator, a Payload Operator, and other participating organizations which may have a significant impact on the particular flight; (2) joint products applicable to all Payload Operations Centers which fulfill a function or group of related functions on a specific discipline or task; and (3) joint products fulfilling a function or group of functions which are applicable on a limited basis to certain payload-related facilities.

1.9.1 Functions Common to STS Flight Operator and Payload Operators

Eight major joint functions have been identified as being applicable to both STS Flight Operation and Payload Operator participation. These joint functions are:

- Flight Requirements Definition
- Scheduling (Program and Implementation)
- Flight Design
- STS/Payload Flight Planning Data Generation
- STS/Payload Crew Activity Planning and Flight Data File Generation
- STS/Payload Integration
- STS/Payload Personnel Planning
- Training and Simulations Planning

Flight requirements definition is the responsibility of the Payload Operator, but must be defined within the scope and capability of the STS. (Flight requirements formats and STS User Handbook will be a useful input to the Payload Operator for this.) The STS Operator is responsible for the remaining functions, but requires the active, joint participation of the Payload Operator responsible for the payload flight. Participation on all of these functions may be further reallocated or subdivided by the STS Operator or Payload Operator within their respective organizations.

1.9.2 Products and Functions Common to All Payload Operators

As a result of this study, certain products and functions have been identified which are applicable to all Payload Operators. These products and functions are presented in Table 1.9-1, Products and Functions Common to All Payload Operators. This table presents a list of products whose specific functions were previously identified in Section 1.4, and indicates whether or not a POC/Payload Operator is required to implement the function(s) which result in the specified product. Products required of a Payload Operator which are generally applicable to all operationally-related activities at the applicable POC are identified with a check mark (✓); products which are applicable only to certain aspects of STS-related operations are identified specifically. These products are intended to include all payload-related functions relative to nominal, off-nominal, and contingency operations to be exercised during a flight, by flight crews or flight operations support personnel.

A specific comment directed at DOD participation with the STS is needed here. While DOD participates as a STS User, the same products and functions must be produced and accomplished by DOD (or for DOD operations) as for any other payload flight; however, due to the nature of DOD operations, some products or functions which are normally produced or performed by the STS Flight Operator may be performed by DOD due to security requirements. These products or functions will be retained within the DOD organization and not circulated publicly, or privately, to other STS Users. The total impact of DOD security requirements on that portion of STS operations is not well defined, and lies outside the scope of this study.

Table 1.9-1. Products and Functions Common to All Payload Operators

PRODUCT \ POC-PAYLOAD OPERATOR CATEGORY	JSC POC-SPACELAB PAYLOAD OPERATORS	GSFC POC-AUTO EARTH-ORBIT PAYLOAD OPERATORS	JPL POC-PLANETARY PAYLOAD OPERATORS	DOD POC-*DOD PAYLOAD OPERATORS
STDN/TDRSS REQUIREMENTS	✓	✓	✓	CONTINGENCY
BOP ANNEX	✓	✓	✓	✓
FLIGHT RULES	✓	✓	✓	✓
FLIGHT RULES RATIONALE	✓	✓	✓	✓
LAUNCH RULE INPUTS	✓	✓	✓	✓
CREW PROCEDURES MANAGEMENT PLAN	✓	✓	✓	✓
FLIGHT TECHNIQUES	✓	✓	✓	✓
PRODUCT SCHEDULES	✓	✓	✓	✓
REFERENCE MISSION DOCUMENTS	✓	✓	✓	✓
FLIGHT DATA FILE (FDF)	✓	✓	✓	✓
SUMMARY/DETAILED CREW ACTIVITY PLAN	✓	✓	✓	✓
FLIGHT DEBRIEFING PLAN	✓	✓	✓	✓
FLIGHT DEBRIEFING REPORT	✓	✓	✓	✓
FDF DISTRIBUTION AND LOGISTICS CONTROL PLAN	✓	✓	✓	✓
FLIGHT OPERATIONS INTEGRATION HANDBOOK	✓	✓	✓	✓
COMM AND DATA OPERATIONS PLAN	VIA STDN/TDRSS	VIA STDN/TDRSS	VIA STDN/TDRSS	VIA RTS
STS CONSUMABLES MANAGEMENT PLAN	✓	✓	✓	✓
PAYLOAD HANDLING (LOGISTICS) PLAN	✓	✓	✓	✓

*SEE COMMENTS IN TEXT, PAGE 1-106

Table 1.9-1. Products and Functions Common to All Payload Operators (Continued)

PRODUCT \ POC-PAYLOAD OPERATOR CATEGORY	JSC POC-SPACELAB PAYLOAD OPERATORS	GSFC POC-AUTO EARTH-ORBIT PAYLOAD OPERATORS	JPL POC-PLANETARY PAYLOAD OPERATORS	DOD POC-*DOD PAYLOAD OPERATORS
INTEGRATED FLIGHT PROCEDURES	✓	✓	✓	✓
SIMULATION EVALUATION REPORTS	✓	✓	✓	✓
TRAINING PROGRAM AND SYLLABUS	✓	✓	✓	✓
CLASSROOM LESSON PLAN	✓	✓	✓	✓
TRAINER LESSON PLANS AND MATERIAL	✓	✓	✓	✓
SIMULATION SCRIPTS	✓	✓	✓	✓
TRAINING PROGRESS REPORTS	✓	✓	✓	✓
NETWORK OPERATIONS SUPPORT PLAN	✓	✓	✓	CONTINGENCY
RANGE SAFETY INTERFACE PROCEDURES	✓	✓	✓	✓
CREW EQUIPMENT FLIGHT RULES	✓	✓	✓	✓
CREW INTEGRATION PLAN	✓	✓	✓	✓
SAFETY ASSESSMENT REPORT	✓	✓	✓	✓
SYSTEMS INTERFACE HANDBOOK	✓	✓	✓	✓

*SEE COMMENTS IN TEXT, PAGE 1-106

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1.9.3 Products and Functions Applicable to Certain POC's or Support Facilities

Certain products and functions have been identified which are applicable only to certain POC's/Payload Operations or other STS support facilities or Centers. These products are identified in Table 1.9-2, Products and Functions Applicable to Certain POC's/Payload Operations or Support Facilities. The function or functions of these products have been previously identified in Section 1.4; the requirement for such a function to be implemented at a Center or facility which results in one of the products specified is signified by a check mark (✓) in the appropriate column.

Comments applicable to DOD products of functions presented in Section 1.9.2 are also applicable here.

1.9.4 Payload Organization Equivalents of Some STS Operator Products and Functions

During the process of identifying joint products and functions for allocation to organizations involved in the STS, some products and functions were identified for which the payload organization must have equivalents to those in the STS organization. These products, whose function(s) have been previously established in Section 1.4, are presented in Table 1.9-3, Allocation of Payload Equivalents of STS Products and Functions. While these products and functions are generated within the payload organizations, and deal with payload-related systems and equipment, they may be used by the STS Flight Operator for planning purposes. They are included here for completeness.

Table 1.9-2. Products and Functions Applicable to Certain POC's or Support Facilities

PRODUCT \ FUNCTION REQUIREMENTS	JSC POC-SPACELAB PAYLOAD OPERATORS	GSFC POC-AUTO EARTH-ORBIT PAYLOAD OPERATORS	GSFC NOCC-NETWORK OPERATORS	JPL POC-PLANETARY PAYLOAD OPERATORS	DOD POC-*DOD PAYLOAD OPERATORS	LAUNCH/LANDING SITE OPERATORS
BOP ANNEX			✓			
IUS/TUG/KICK STAGE REQUIREMENTS AND OPERATIONS PLANS		✓		✓	✓	
SPACELAB PAYLOAD SUPPORT SYSTEM FLIGHT SOFTWARE HANDBOOK	✓					
SUPPORT INSTRUMENTATION REQUIREMENTS DOCUMENT (SIRD)			✓			
NETWORK TEST PLAN			✓			
NETWORK SUPPORT PLAN			✓			
PROGRAM REQUIREMENTS DOCUMENT (PRD)						✓
INTEGRATED CREW ACTIVITY PLAN	✓	✓		✓	✓	

*SEE COMMENTS IN TEXT, PAGE 1-109

Table 1.9-3. Allocation of Payload Equivalents of STS Products and Functions

PRODUCT \ FUNCTION REQUIREMENT	JSC POC-SPACELAB PAYLOADS	GSFC POC-AUTO EARTH-ORBIT PAYLOADS	JPL POC-PLANETARY PAYLOADS	DOD POC-DOD PAYLOADS*
ONBOARD CREW EQUIPMENT OPERATIONAL REQUIREMENTS	✓	IF REQUIRED	IF REQUIRED	IF REQUIRED
POC/POCC REQUIREMENTS	✓	✓	✓	✓
PROGRAM MANAGEMENT AND SUPPORT PLAN	✓	✓	✓	✓
GROUND SYSTEMS REQUIREMENTS PREP.	✓	✓	✓	✓
CREW SYSTEMS HANDBOOK	✓	IF REQUIRED	IF REQUIRED	IF REQUIRED
PAYLOAD SUPPORT SYSTEMS REQUIREMENTS	✓	✓	✓	✓
CREW SYSTEMS OPERATING PROCEDURES	✓	IF REQUIRED	IF REQUIRED	IF REQUIRED
CLASSROOM TRAINING MATERIAL	✓	✓	✓	✓
SIMULATION PROCEDURES HANDBOOK	✓	✓	✓	✓
SIMULATION CHECKOUT PLANS	✓	✓	✓	✓
SIMULATION EVALUATION PLANS	✓	✓	✓	✓
TRAINING SCHEDULES (PAYLOAD ONLY)	✓	✓	✓	✓
TRAINING MANAGEMENT PLAN	✓	✓	✓	✓
TRAINING CONCEPTS	✓	✓	✓	✓
TRAINING DATA FILE DEFINITION	✓	✓	✓	✓
SPECIALIZED TRAINING PACKS	✓	IF REQUIRED	IF REQUIRED	IF REQUIRED
CONSOLE HANDBOOKS	✓	✓	✓	✓
COMMAND PLANS AND PROCEDURES	✓	✓	✓	✓
SYSTEMS INSTRUMENTATION REQUIREMENTS DOCUMENT	✓	✓	✓	✓

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1.10 SUMMARY

The objective of this study task has been to identify joint products and functions applicable to preflight planning of flight operations, training and simulations, as related to the STS and assigned Payloads; to allocate those products and functions to the STS or Payload organizations which have the necessary capabilities and facilities to produce the products or conduct the specified functions; and to recommend additional facilities where required, to fulfill the needs of the Payload organizations in conducting joint operations with the STS Flight Operator.

These products and functions have been identified in Sections 1.3 and 1.4; the facilities capable of supporting the specified planning, training and simulation activities were identified in Section 1.6, along with suggestions for supplemental facilities outlined in Section 1.7; criteria for allocation of these products and functions were presented in Section 1.8; and the tasks were allocated according to the established criteria in Section 1.9.

Listed below are some general conclusions and recommendations derived during the course of this Study task.

1.10.1 Conclusions

- The STS Flight Operator and potential Payload Operators are ready for definite assignment of functions and products regarding preflight planning of flight operations, training and simulations. For example, Payload Operator prepare Payload Flight Requirements in accordance with outline and format conceived jointly by the STS Flight Operator/Payload Operators; STS Flight Operator publish Flight Trajectory Design and Integrated Crew Activity Plan as developed through integrated STS Flight Operator/Payload Operator activities; STS Flight Operator document Joint Crew Training Requirements and Plan based on integrated STS Flight Operator/Payload Operator approach, which optimizes training for both STS and Payload crews, etc.

- There is an urgent need among Payload Developers/Payload Operators for Guidelines, Formats, and Instructions for Submitting Payload Data to the STS Flight Operator. An up-to-date STS User Handbook, thorough in detail, is required by the Payload Community.

- Of all the products required to record planning data for that portion of an STS flight operation involving a Payload, approximately one-third are basic documents which change only in an evolutionary manner; approximately one-third are related to flight types, and

may or may not require revision for a specific flight; and the remainder are flight-specific documents applicable only to one flight. For most of the flight-specific documents, the formats are predetermined and the contents similar to previously-flown missions.

- The starting point for Operations Planning (preparation of Flight Implementation Packages) is a variable dependent on familiarity with the payload or payload complexity, for example, requiring (1) a new Implementation Package - start L-2 years, or (2) a revised Implementation Package - start L-1 year, or (3) a standard Implementation Package - start L-4 months.

- Sufficient facilities exist now to commence all phases of STS/Payload flight operations; adequate payload-related facilities exist to begin payload operations for early flights. Additional training or simulation capabilities will be required for some payloads.

- There is a need to negotiate and document specific Interface Definition and Control Agreements between POC/POCC's and MCC-H; similarly Network-MCC/H Interface Definition and Control Agreements are required.

- Payload Operators generally have not anticipated needs for pre-flight planning documentation for flight or for training at this time.

- STS Flight Operator is in the best position to take the Lead Role on integrated training and simulation operations, requiring support of STS Facilities and Payload Facilities.

- Functions and products to be generated by Payload Operations Centers plus POCC capabilities need to be identified and distributed to the STS User Community.

- For payload development and support facilities, portable facilities such as remote POCC's, or facilities for conducting real-time scientific investigations, may be utilized to provide adequate joint payload operational support with a minimum amount of expense.

- There is limited opportunity, if any, for training on payload experiment flight configurations prior to flight (during KSC operations only).

- There are many opportunities to develop and utilize "standard" modules for planning and preparing for STS/Payload flight operations.

- An integrated Network Operations Control Center (NOCC) is needed to optimize control of all NASA tracking and data acquisition resources, since scheduling and control will increase as STS Payload flight operations mature.

- For Planetary and Automated Earth-Orbital Payloads, the only major difference between current operations and STS flight operations is the method of payload delivery; post-delivery operations of the payloads will not be affected.

1.10.2 Recommendations

- Action should begin immediately to identify the organizational structure and functions of all POC's (including POCC's), in order that equivalent disciplines in the STS and Payload organizations may be identified, and interfaces may be established at both the formal and informal level, to whatever degree required. The respective roles of STS Flight Operator and Payload Operators on preflight planning functions for flight operations, training and simulations should be reviewed and agreed to by both STS Flight Operator and Payload Operator Community Representatives.

- Selected real payloads representative of the most "active" flight types should be used to develop preflight planning products, functions and procedures as expeditiously as possible. All products should be built/documented with a view to reuse and easy updating.

- Guidelines, formats and instructions for preparing and submitting payload data to the STS Flight Operator should be distributed to the STS User Community as expeditiously as possible.

- The respective roles of the STS Flight Operator and Payload Operators on preflight planning functions for flight operations, training and simulations should be defined at this time and reviewed by both STS Flight Operator and Payload Operator Community Representatives.

- Formal Documentation (with approval cycles) should be used only when necessary; STS/Payload Interface Contacts should be established and exercised to maximum extent prior to document approvals.

- Interfaces between the STS Flight Operator and Payload Operators should be as similar as possible in order to maximize system efficiency. Hardwire interfaces (communications, data, etc.) should also be as similar as possible to facilitate data distribution with maximum efficiency.

- All documents, whether basic, flight-type, or flight-specific, should be modularized as much as possible to facilitate and minimize updating; and data contained in these documents should be formatted to make maximum use of data worksheets, or automated data recovery from such devices as the Generalized Documentation Processor (GDP).

- Guidelines should be established for timing the "start schedule" for preparing "Flight Operations Implementation Packages," depending on flight complexity, e.g., L-2 years for very complex and L-4 months for standard or repeat flights.

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